SEMESTER I

MAT 101	LINEAR ALGEBRA AND CALCULUS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analysing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analysing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisite: A basic course in one-variable calculus and matrix theory.

Course Outcomes: After the completion of the course the student will be able to

CO 1	solve systems of linear equations, diagonalize matrices and characterise quadratic forms
CO 2	compute the partial and total derivatives and maxima and minima of multivariable functions
CO 3	compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas
CO 4	perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent
CO 5	determine the Taylor and Fourier series expansion of functions and learn their applications.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	2	3	2	1	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms

1. A is a real matrix of order $3 \times 3$and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution of $AX = 0$if rank of A is 1? 2 ?3?
2. Given$A = \begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix Pthat diagonalizes A.
3. Find out what type of conic section the following quadratic form represents

$$17x^2 - 30x_1x_2 + 17x_2^2 = 128$$

4. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$has an eigen value5 with corresponding Eigen vector$X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$. Find A^5X

Course Outcome 2 (CO2): compute the partial and total derivatives and maxima and minima of multivariable functions

1. Find the slope of the surface $z = x^2y + 5y^3$in the x-direction at the point (1,-2)

2. Given the function $w = xy + z$, use chain rule to find the instantaneous rate of change of $w$at each point along the curve $x = cost, y = sint, z = t$

3. Determine the dimension of rectangular box open at the top , having a volume 32 cubic ft and requiring the least amount of material for it's construction.

Course Outcome 3(CO3): compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y)\, DA$where D is the region bounded by the parabolas $y = 2x^2$and $y = 1 + x^2$

2. Explain how you would find the volume under the surface $z = f(x, y)$and over a specific region Din the xyplane using (i) double integral (ii) triple integral?

3. Find the mass and centre of gravity of a triangular lamina with vertices (0,0), (2,1), (0,3) if the density function is $f(x, y) = x + y$

4. Use spherical coordinates to evaluate $\iiint_B (x^2 + y^2 + z^2)^3\, dV$where B is the unit ball defined by $B = \{(x, y, z): x^2 + y^2 + z^2 \leq 1\}$

Course Outcome 4 (CO4): perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. What is the difference between a sequence and a series and when do you say that they are convergent? Divergent?

2. Determine whether the series $\sum_{n=1}^{n=\infty} \frac{5}{2n^2+4n+3}$converges or diverges.

3. Is the series $\sum_{n=1}^{n=\infty} \frac{(-1)^{n-1}}{n}$convergent? Absolutely convergent? Conditionally convergent?

Course Outcome 5 (CO5): determine the Taylor and Fourier series expansion of functions and learn their applications.

1. Assuming the possibility of expansion find the Maclaurin series expansion of

   $f(x) = (1 + x)^k$for$|x| < 1$where $k$is any real number. What happens if $k$is a positive

   integer?

2. Use Maclaurin series of $ln(1 + x), -1 < x \leq 1$to find an approximate value of$ln2$.

3. Find the Fourier series of the function$f(x) = x^2, -2 \leq x < 2, f(x + 4) = f(x)$. Hence using Parseval's identity prove that $1 + \frac{1}{2^4} + \frac{1}{3^4} + \ ... \ = \frac{\pi^4}{90}$

4. Expand the function $f(x) = x\ (0 < x < 1/2)$ into a (i) Fourier sine series (ii) Fourier cosine series.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* MAT 101**

Max. Marks: 100 **Duration: 3 Hours**

LINEAR ALGEBRA AND CALCULUs

(2019-Scheme)

(Common to all branches)

PART A

(Answer **all** questions, **each** question carries 3 marks)

1. Determine the rank of the matrix $A = \begin{bmatrix} 1 & 2 & -1 \\ -2 & -4 & 2 \\ 3 & 6 & -3 \end{bmatrix}$.
2. Write down the eigen values of $= \begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$. What are the eigen values of $P^{-1}AP$ where $P = \begin{bmatrix} -4 & 2 \\ 3 & -1 \end{bmatrix}$?
3. Find $f_x(1,3)$ and $f_y(1,3)$ for the function $f(x,y) = 2x^3y^2 + 2y + 4x$.
4. Show that the function $u(x,t) = \sin(x - ct)$ is a solution of the equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.
5. Use double integral to find the area of the region enclosed between the parabolas $y = \frac{1}{2}x^2$ and the line $y = 2x$.
6. Use polar coordinates to evaluate the area of the region bounded by $x^2 + y^2 = 4$, the line $y = x$ and the y axis in the first quadrant
7. Test the convergence of the series $\sum_{k=1}^{\infty} \frac{k}{k+1}$.
8. Test the convergence of the alternating series $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{1}{k}$ using Leibnitz test.
9. Find the Taylor series expansion of $sin \pi x$ about $x = \frac{1}{2}$.
10. Find the values to which the Fourier series of

    $f(x) = x$ for $-\pi < x < \pi$, with $f(x + 2\pi) = f(x)$ converges (10x3=30)

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. (a) Solve the following system of equations

$$y + z - 2w = 0$$
$$2x - 3y - 3z + 6w = 2$$
$$4x + y + z - 2w = 4$$

(b) Find the eigen values and eigen vectors of the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

12. (a) Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 1 & 4 \end{bmatrix}$

(b) What kind of conic section the quadratic form$3x_1^2 + 22x_1x_2 + 3x_2^2 = 0$ represents? Transform it to principal axes.

Module - II

13. (a) Find the local linear approximation to $f(x, y) = \sqrt{x^2 + y^2}$ at the point $(3, 4)$.Use it to approximate $f(3.04, 3.98)$

(b) Let $w = \sqrt{x^2 + y^2 + z^2}, \quad x = cos\theta, y = sin\theta, z = tan\theta$. Use chain rule to find $\frac{dw}{d\theta}$when $\theta = \frac{\pi}{4}$.

14. (a) Let $z = f(x, y)$ where $x = rcos\theta, y = rsin\theta,$ prove that $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2.$

(b) Locate all relative maxima, relative minima and saddle points $f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y} (a \neq 0, b \neq 0).$

Module - III

15. (a) Evaluate$\iint_D (2x^2y + 9y^3)\, dxdy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$

(b) Evaluate $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3}\, dxdy$ changing the order of integration.

16. (a) Find the volume of the solid bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$..

(b) Evaluate $\iiint \sqrt{1 - x^2 - y^2 - z^2}\, dxdydz$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$, by transforming to spherical polar coordinates

Module - IV

17. (a) Test the convergence of the series

(i) $\sum_{k=1}^{\infty} \frac{k^k}{k!}$ (ii) $\sum_{k=2}^{\infty} \left(\frac{4k-5}{2k+1}\right)^k$

(b) Determine the convergence or divergence of the series $\sum_{k=1}^{\infty} (-1)^k \frac{(2k-1)!}{3^k}$

18. (a) Check whether the series $\sum_{k=1}^{\infty} (-1)^{k+1} \frac{(2k)!}{(3k-2)!}$is absolutely convergent, conditionally convergent or divergent.

(b) Test the convergence of the series $1 + \frac{1.2}{1.3} + \frac{1.2.3}{1.3.5} + \frac{1.2.3.4}{1.3.5.7} + \cdots$

Module - V

19. (a) Obtain the Fourier series of for $f(x) = e^{-x}$, in the interval $0 < x < 2\pi$.with $f(x + 2\pi) = f(x)$. Hence deduce the value of $\sum_{n=2}^{\infty} \frac{(-1)^n}{1+n^2}$.

(b) Find the half range sine series of $f(x) = \begin{cases} \frac{2kL}{x} & if\ 0 < x < \frac{L}{2} \\ \frac{2k(L-x)}{L} & if\ \frac{L}{2} < x < L \end{cases}$

20. (a)Expand $(1 + x)^{-2}$.as a Taylor series about $x = 0$and state the region of convergence of the series.

(b) Find the Fourier series for $f(x) = x^2$ in the interval $-\pi < x < \pi$

with $f(x + 2\pi) = f(x)$.Hence show that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \cdots = \frac{\pi^4}{90}$. (14X5=70)

Syllabus

Module 1 (Linear algebra)

(Text 2: Relevant topics from sections 7.3, 7.4, 7.5, 8.1,8.3,8.4)

Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigen vectors. Diagonaliztion of matrices, orthogonal transformation, quadratic forms and their canonical forms.

Module 2 (multivariable calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Concept of limit and continuity of functions of two variables, partial derivatives, Differentials, Local Linear approximations, chain rule, total derivative, Relative maxima and minima, Absolute maxima and minima on closed and bounded set.

Module 3(multivariable calculus-Integration)

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas and volume using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

Module 4 (sequences and series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series(without proof), test of convergence (comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

Module 5 (Series representation of functions)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formulas, Convergence of Fourier series (without proof), half range sine and cosine series, Parseval's theorem (without proof).

Text Books

1. H. Anton, I. Biven,S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10thEdition, John Wiley & Sons, 2016.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson, Reprint, 2002.
3. Peter V. O'Neil, Advanced Engineering Mathematics , Cengage, 7th Edition, 2012
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

Course Contents and Lecture Schedule

No	**Topic**	**No. of Lectures**
1	**Linear Algebra (10 hours)**	
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	3
1.3	Eigen values and eigen vectors	2
1.4	Diagonaliztion of matrices, orthogonal transformation, quadratic forms	4

	and their canonical forms.	
2	**Multivariable calculus-Differentiation (8 hours)**	
2.1	Concept of limit and continuity of functions of two variables, partial derivatives	2
2.2	Differentials, Local Linear approximations	2
2.3	Chain rule, total derivative	2
2.4	Maxima and minima	2
3	**Multivariable calculus-Integration (10 hours)**	
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar),	2
3.3	Finding areas and volumes, mass and centre of gravity of plane laminas	3
3.4	Triple integrals	3
4	**Sequences and series (8 hours)**	
4.1	Convergence of sequences and series, geometric and p-series	2
4.2	Test of convergence(comparison, ratio and root)	4
4.3	Alternating series and Leibnitz test, absolute and conditional convergence	2
5	**Series representation of functions (9 hours)**	
5.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions;	3
5.2	Fourier series, Euler formulas, Convergence of Fourier series(Dirichlet's conditions)	3
5.3	Half range sine and cosine series, Parseval's theorem.	3

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
   (b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
   (b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
   (b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

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Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.

2. Distinguish between longitudinal and transverse waves.

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.

8. Describe the method of non-destructive testing using ultra sonic waves

9. Explain the condition of population inversion

10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is $7\times10^{4.}$ Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t) m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

(b) The volume of a hall is 3000 m^3. It has a total absorption of 100m^2 sabine. If the hall is filled with audience who add another 80 m^2sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

(b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)

(b) What is the principle of holography? How is a hologram recorded? (6)

20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)

SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003

2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015

3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016

4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015

5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017

6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007

7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005

8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017

9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Acoustics & Ultrasonics (9hrs)**	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	**Laser and Fibre optics (9hours)**	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

PHT 100	ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Classify the properties of magnetic materials and apply vector calculus to static magnetic fields and use Maxwell's equations to diverse engineering problems
CO 5	Analyze the principles behind various superconducting applications, explain the working of solid state lighting devices and fibre optic communication system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3	1						1	2			1
CO 5	3	1						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.

   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.

   (b) A liquid of refractive index μ is introduced between the lens and glass plate.

What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function ?
2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.

   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Compare displacement current and conduction current.
2. Mention any four properties of ferro magnetic materials.
3. (a) Starting from Maxwell's equations, derive the free space electromagnetic wave equation and show that velocity of electromagnetic wave is $1/(\mu_o \varepsilon_o)^{1/2}$

   (b) An electromagnetic wave is described by $E = 100 \exp 8\pi i [10^{14} t - (10^6 z / 3)]$ V/m. Find the direction of propagation of the wave,speed of the wave and magnetic flux density in the wave.

Course Outcome 5 (CO5):

1. Explain the working of a solar cell.
2. Distinguish between Type I and Type II super conductors.
3. (a) Define numerical aperture and derive an expression for it.

   (b) Explain the working of intensity modulated fibre optic sensor.

Model Question paper

QP CODE: PAGES:3

Reg No:______________

Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 100

Course Name: Engineering Physics A

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators

2. Distinguish between longitudinal and transverse waves

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. State Faraday's laws of electromagnetic induction.

8. Compare displacement current and conduction current

9. List four important applications of superconductors.

10. Give the working principle of LED. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution.Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value.(4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t)m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv)Velocity of the wave. (4)

Module 2

13.(a)Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid. (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15.(a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16.(a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17.(a) State Poynting's Theorem. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is 3.8×10^{26} W and its radius is 7×10^{8} m. (5)

(b) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. (9)

18.(a) Starting from Maxwell's Equations, derive electromagnetic wave equations in free space. (10)

(b) If the magnitude of **H** in a plane wave is 1 A/m, find the magnitude of **E** in free space. (4)

Module 5

19.(a) Show that superconductors are perfect diamagnets. Distinguish between Type I and Type II superconductors with suitable examples. (10)

(b) Write a short note on high temperature superconductors. (4)

20.(a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33. (4)

(14x5=70)

Syllabus

ENGINEERING PHYSICS A
(FOR CIRCUIT BRANCHES)

Module 1
Oscillations and Waves
Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2
Wave Optics
Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3
Quantum Mechanics & Nanotechnology
Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4
Magnetism & Electro Magnetic Theory
Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux, Magnetic permeability and susceptibility, Classification of magnetic materials-para, dia and ferromagnetic materials

Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem, Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)

Module 5

Superconductivity & Photonics

Superconducting phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II, BCS Theory (Qualitative), High temperature superconductors-Applications of super conductivity

Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics, Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors.

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition 2019

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. Halliday, Resnick, Walker, "Fundamentals of Physics'', John Wiley & Sons.Inc, 2001
8. David J Griffiths, "Introduction to Electrodynamics'', Addison-Wesley publishing, 3rd Edition, 1999
9. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition,2017
10. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
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1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves. Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
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2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hr
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2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
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3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
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3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Magnetism & Electro Magnetic Theory (9 hours)**	
4.1	Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux	2 hrs

	density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux	
4.2	Explanation for Magnetic permeability and susceptibility Classification of magnetic materials- para, dia and ferromagnetic materials	1 hr
4.3	Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem	2 hrs
4.4	Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)	4 hrs
5	**Superconductivity &Photonics (9hours)**	
5.1	Super conducting Phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II	2 hrs
5.2	BCS Theory (Qualitative), High temperature superconductors, Applications of super conductivity	2 hrs
5.3	Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics	2 hrs
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B. Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)

2. List three important advantages of potentiometric titration (3 Marks)

3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)

(b) Calculate the emf of the following cell at 30°C, Z n / Zn^{2+} (0.1M) // Ag^{+} (0.01M) // Ag.

Given E^0 Zn^{2+}/Zn = -0.76 V, E^0 Ag^{+}/Ag = 0.8 V. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)

2. List the important applications of IR spectroscopy (3 Marks)

3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^1H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)

(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1}. Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $CaC_2O_4.\ H_2O$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for CH_3-$(CHOH)_2$-COOH (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO3 per liter,50 mL of this required 30mL of EDTA solution, 50mL of sample water required 20mL of EDTA solution. 50mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.:________________ Name:____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

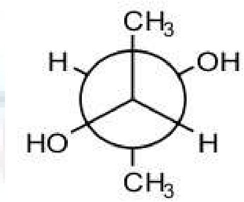
Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks Marks

1	What is potentiometric titration? How the end point is determined graphically?	(3)
2	What is Galvanic series? How is it different from electrochemical series?	(3)
3	Which of the following molecules can give IR absorption? Give reason? (a) O_2 (b) H_2O (c) N_2 (d) HCl	(3)
4	Which of the following molecules show UV-Visible absorption? Give reason. (a) Ethane (b) Butadiene (c) Benzene	(3)

5		What are the visualization techniques used in TLC?	(3)
6		Write the three important applications of nanomaterials.	(3)
7		Draw the Fischer projection formula and find R-S notation of	(3)



8		Write the structure of a) Polypyrroleb) Kevlar.	(3
9		What is break point chlorination?	(3)
10		What is reverse osmosis?	(3)

PART B

Answer any one full question from each module, each question carries 14 marks

Module 1

11	a)	Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged.	(10)
	b)	Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M.	(4)

OR

12	a)	Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments.	(10)
	b)	Given below are reduction potentials of some species	(4)

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$; $E^0 = +1.51$ V

$Cl_2 + 2e \rightarrow 2Cl^-$; $E^0 = +1.36$ V

$S_2O_8^{2-} + 2e \rightarrow 2SO_4^{2-}$; $E^0 = +1.98$ V

Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving $KMnO_4$.

Module 2

13	a)	What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers.	(10)
	b)	A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution.	(4)

OR

14	a)	Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples.	(10)
	b)	Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active?	(4)

Module 3

15	a)	Explain the principle, instrumentation and procedure involved in gas chromatography.	(10)
	b)	Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch.	(4)

OR

16	a)	Explain the various chemical methods used for the synthesis of nanomaterial	(10)
	b)	How TGA is used to analyse the thermal stability of polymers?	(4)

Module 4

17	a)	What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case?	(10)
	b)	What is ABS? Give properties and applications.	(4)

OR

18	a)	Explain the various structural isomers with suitable example.	(10)
	b)	What is OLED? Draw a labelled diagram.	(4)

Module 5

19	a)	What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated?	(10)
	b)	50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage.	(4)

OR

20	a)	What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter.	(10)
	b)	Calculate the temporary and permanent hardness of a water sample which contains $[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L.	(4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of E^0 using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC-Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.

2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4thedn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George,RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	**Electrochemistry and Corrosion**	**9**
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	**2**
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	**3**
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	**2**
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	**2**
2	**Spectroscopic Techniques and Applications**	**9**
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals).	**2**
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	**2**
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	**2**
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	**3**
3	**Instrumental Methods and Nanomaterials**	**9**
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	**2**

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	**2**
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	**2**
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	**3**
4	**Stereochemistry and Polymer Chemistry**	**9**
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	**2**
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	**1**
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	**2**
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	**4**
5	**Water Chemistry and Sewage Water Treatment**	**9**
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	**3**
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.	**2**
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	**2**
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	**2**

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics***)**

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body***)**

1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

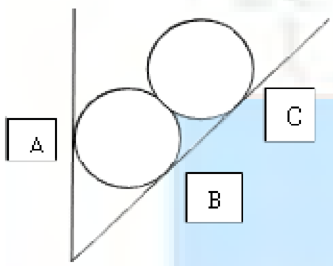
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

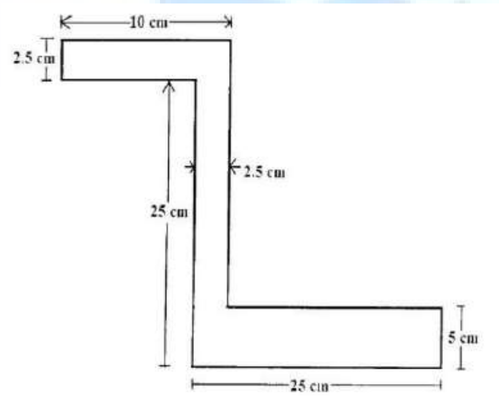


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
	Total		14

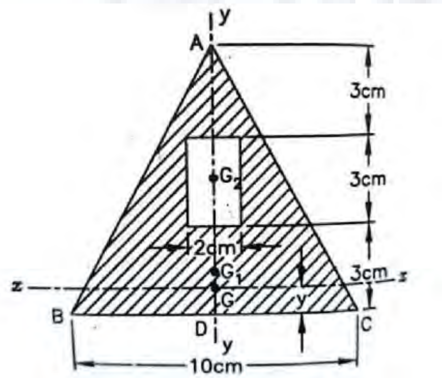
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.:_______________

Name:___________________________ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

7. Compare damped and undamped free vibrations.

8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.

9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.

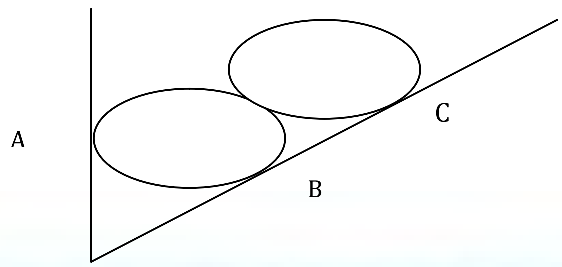
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30^{o} with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

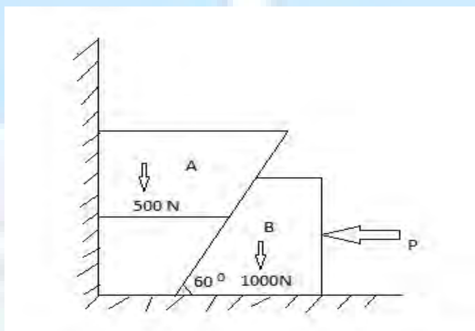


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta = 30^o$, The diameter of pulley B is negligible. (14 marks)

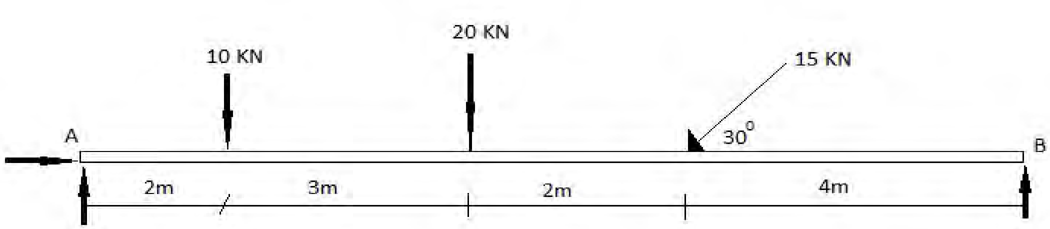
Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)

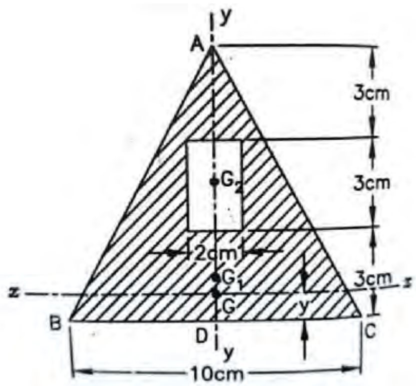


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.
Find the reactions at A & B. (14 marks)



Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC. (14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the —z direction. Corner *C* is tied to *D* by a rope. The triangle is weightless. Determine the unknown force components acting at *A*, *B*, and *C*. (14 marks)

Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30^0 to the horizontal with an initial velocity of 20 m/s , hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)

20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder- analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia,radius of gyration,mass moment of inertia-ring,cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	**Module 1**		**Total: 7**
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	**Module 2**		**Total: 7**
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,C04 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	**Module 3**		**Total: 7**
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	**Module 4**		**Total: 7**

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D'Alembert's principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collusions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	**Module 5**		**Total: 7**
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1

EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of soilds
2. Draw Isometric views/projections of combination of soilds
3. Draw Perspective views of Soilds

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE: PAGES:3

Reg No:______________

Name :______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines
Show necessary dimensions
Answer any ONE question from each module
Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.

2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^{o} to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30^{o} to HP and 45^{o} to VP. Draw the projections of the solid.

MODULE III

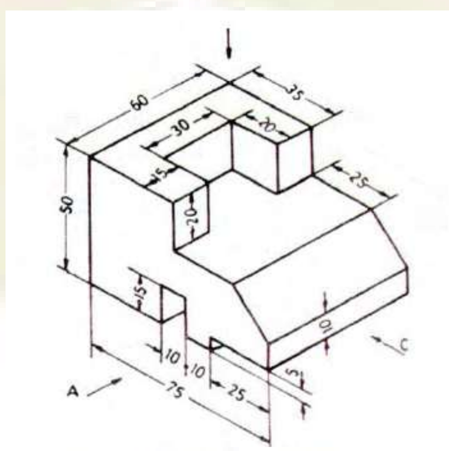
5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.
8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.
10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

Time : 3 hours **EST110 ENGINEERING GRAPHICS** **Max. Marks: 100**

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
   Finding true length by any one method – 6 marks
   Finding true inclination with VP – 2 marks
   Finding true inclination with HP – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

2. Locating the points and drawing true length of the line – 4 marks
   Finding projections by any method – 6 marks
   Finding length of elevation and plan – 2 marks
   Finding apparent inclinations – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

3. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used.
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

4. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

5. Drawing initial position plan and elevation – 4 marks
   Locating section plane as per given condition – 5 marks
   Drawing true shape -5 marks
   Finding inclination of cutting plane – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

6. Drawing initial position plan and elevation – 4 marks
   Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
   Isometric View of Slab -6 marks
   Isometric View of Frustum – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.
   Reduce 4 marks if Isometric scale is taken)

8. Drawing initial positions – 4 marks
   Isometric scale – 4 marks
   Isometric projection of prism -5 marks
   Isometric projection of sphere – 5 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
   Locating elevation points – 2 marks
   Locating plan points – 2 marks
   Drawing the perspective view – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

10. Drawing the elevation – 8marks
    Drawing the plan – 4 marks
    Drawing the side view – 4 marks
    Marking invisible edges – 2 marks
    Dimensioning and neatness – 2 marks

    Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.
Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.
Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.
Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)
Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	**SECTION A**	No. of Hours
1	**MODULE I**	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	**MODULE II**	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	**MODULE III**	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	**MODULE IV**	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	**MODULE V**	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B *(To be conducted in CAD lab)*	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			**Basic Mechanical Engineering**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (marks)**	**Continuous Assessment**		**End Semester Examination (marks)**
	Test 1 marks	**Test 2 marks**		**Test 1 marks**	**Test 2 marks**	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1.Explain relevance of Civil engineering in the overall infrastructural development of the country.
Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering

CO Questions

1. a List out the types of building as per occupancy. Explain any two, each in about five sentences.
b. Discuss the components of a building with a neat figure.

2. a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. **a.** What are the different kinds of cement available and what is their use.
   b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
   b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. **a**. Draw the elevation and plan of one brick thick wall with English bond
   b. Explain the energy systems and water management in Green buildings

2. **a.** Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing.

   b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take Cp = 1.005 kJ/kgK and Cv=0.718 kJ/kgK
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850 °C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: **EST120** page:3

Reg No:___________________

Name:_____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)

b. Discuss the components of a building with a neat figure. (5)

OR

7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

8a. What are the different kinds of cement available and what is their use. (5)

b. List the properties of good building bricks. Explain any five. (5)

OR

9a. List and explain any five modern construction materials used for construction. (5)

b. Explain the objectives and principles of surveying (5)

MODULE III

10a. Draw the elevation and plan of one brick thick wall with English bond (5)

b. Explain the energy systems and water management in Green buildings (5)

OR

11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35^oC, 0.1MPa. The maximum temperature of the cycle is 1100^oC. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii)Cycle efficiency

   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK — 10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches. — 7 marks
   b) Explain the fuel system of a petrol engine. — 3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram. — 7 marks
   b) Define: Specific humidity, relative humidity and dew point temperature. — 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. — 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. — 10 marks

OR

11. a) Describe the arc welding process with a neat sketch. — 6 marks
    b) Differentiate between up-milling and down-milling operations. — 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials**:** types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin,J.,Basic Mechanical Engineering,Pentex Books,9th Edition,2018
12. Balachandran, P.Basic Mechanical Engineering,Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	**Module I**		**Total: 7**
1.1	*General Introduction to Civil Engineering*: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	*Introduction to buildings:* Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	*Building rules and regulations:* Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	*Building area:* Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	**Module 2**		**Total: 7**
2.1	*Surveying:* Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - *Qualities* of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	**Module 3**		**Total: 7**
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	*Basic infrastructure services:* MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	*Green buildings:*- Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	**MODULE 4**		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle-Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	**MODULE 5**		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	**MODULE 6**	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:
This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering(2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

	Basic Electrical Engineering			Basic Electronics Engineering		
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (Marks)**	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**		**Test 1 (Marks)**	**Test 2 (Marks)**	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.

2. Solve problems with Mesh/node analysis.

3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits

2. Problems on parallel magnetic circuits

3. Problems on composite magnetic ciruits

4. **Course Outcome 3 (CO3):**

1. problems on self inductance, mutual inductance and coefficient of coupling

2. problems on rms and average values of periodic waveforms

3. problems on series ac circuits

4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1.What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.

3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.

2. What is a transducer?

3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?

2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?

3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE: Pages: 3

Reg No.:________________

Name:__________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

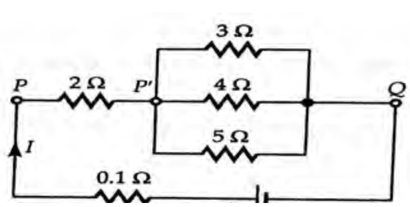
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4Ω resistor in the circuit shown, applying current division rule:



2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.

3. An alternating voltage of (80+j60)V is applied to an RX circuit and the current flowing through the circuit is (-4+j10)A. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.

4. Derive the relation between line and phase values of voltage in a three phase star connected system.

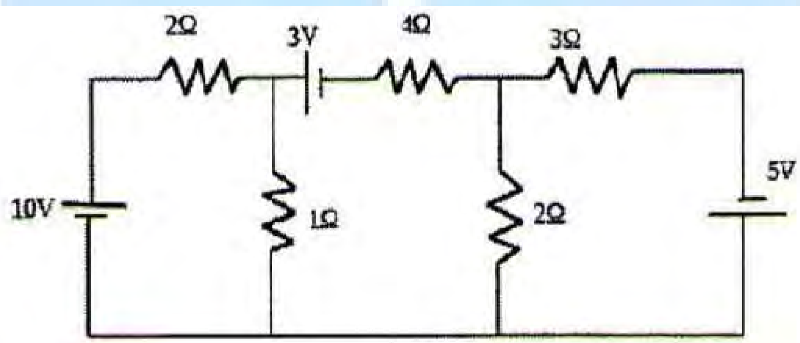
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

Answer one question from each module; each question carries 10 marks.

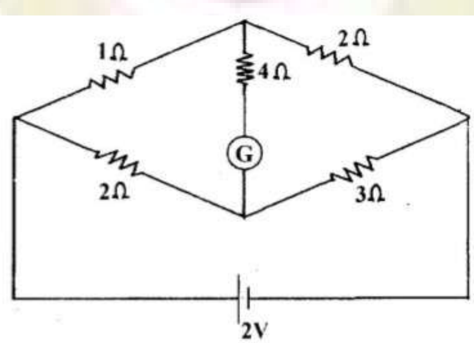
Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)

(b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)

(b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60^0 to the direction of field. (6 marks)

9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)

(b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is $5\,\Omega$ and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.

11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
   b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
   b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
   b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
   b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)
    b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
    b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D C Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, "Electrical Engineering Fundamentals", Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, "Basic Electrical Engineering", Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, "Engineering Circuit Analysis", Tata McGraw-Hill
4. Hughes, "Electrical and Electronic Technology", Pearson Education.
5. V. N. Mittle and Arvind Mittal, "Basic Electrical Engineering," Second Edition, McGraw Hill.
6. Parker and Smith, "Problems in Electrical Engineering", CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, "Fundamentals of Electrical Engineering", Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	***Elementary Concepts of Electric Circuits***	
1.1	**Elementary concepts of DC electric circuits:** Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.	1 2 1
1.2	**Analysis of DC electric circuits:** Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	**Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals**	
2.1	**Magnetic Circuits:** Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	**Electromagnetic Induction:** Faraday's laws, problems, Lenz's law-statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	**Alternating Current fundamentals:** Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	**AC Circuits**	

3.1	**AC Circuits:** Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	**Three phase AC systems:** Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	**Introduction to Semiconductor devices**	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutional perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	**PN Junction diode**: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	**Bipolar Junction Transistors:** PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	**Basic electronic circuits and instrumentation**	
5.1	**Rectifiers and power supplies:** Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	**Electronic Instrumentation:** Block diagram of an electronic instrumentation system	2
6	**Introduction to Communication Systems**	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	**Radio communication:** principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	**Mobile communication:** basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

HUN 101	LIFE SKILLS	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		MNC	2	0	2	---	**2019**

Preamble: Life skills are those competencies that provide the means for an individual to be resourceful and positive while taking on life's vicissitudes. Development of one's personality by being aware of the self, connecting with others, reflecting on the abstract and the concrete, leading and generating change, and staying rooted in time-tested values and principles is being aimed at. This course is designed to enhance the employability and maximize the potential of the students by introducing them to the principles that underly personal and professional success, and help them acquire the skills needed to apply these principles in their lives and careers.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Define and Identify different life skills required in personal and professional life
CO 2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
CO 3	Explain the basic mechanics of effective communication and demonstrate these through presentations.
CO 4	Take part in group discussions
CO 5	Use appropriate thinking and problem solving techniques to solve new problems
CO 6	Understand the basics of teamwork and leadership

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						2		1	2	2	1	3
CO 2									3			2
CO 3						1			1	3		
CO 4										3		1
CO 5		3	2	1								
CO 6						1			3			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation
Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 15 marks
Series test (one test only, should include first three modules)	: 25 marks

Regular assessment

- Group Discussion (Marks: 9)
  Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

  - Communication Skills : 3 marks
  - Subject Clarity : 2 marks
  - Group Dynamics : 2 marks
  - Behaviours & Mannerisms : 2 marks

- Presentation Skills (Marks: 6)
  Identify a suitable topic and ask the students to prepare a presentation (preferably a power point presentation) for about 10 minutes. Parameters to be used for evaluation are as follows:

  - Communication Skills : 2 marks
  - Platform Skills : 2 marks
  - Subject Clarity/Knowledge : 2 marks

End Semester Examination
Total Marks: 50 **Time: 2 hrs.**

Part A: Short answer question (25 marks)
There will be one question from each MODULE (five questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:
(i) Content Clarity/Subject Knowledge
(ii) Presentation style
(iii) Organization of content

Part B: Case Study (25 marks)
The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:
(i) Analyze the case situation
(ii) Key players/characters of the case
(iii) Identification of the problem (both major & minor if exists)
(iv) Bring out alternatives
(v) Analyze each alternative against the problem
(vi) Choose the best alternative
(vii) Implement as solution
(viii) Conclusion

(ix) Answer the question at the end of the case

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List 'life skills' as identified by WHO
2. What do you mean by effective communication?
3. What are the essential life skills required by a professional?

Course Outcome 2 (CO2)

1. Identify an effective means to deal with workplace stress.
2. How can a student apply journaling to stress management?
3. What is the PATH method? Describe a situation where this method can be used effectively.

Course Outcome 3(CO3):

1. Identify the communication network structure that can be observed in the given situations. Describe them.

   (a) A group discussion on development.

   (b) An address from the Principal regarding punctuality.

   (c) A reporter interviewing a movie star.

   (d) Discussing the answers of a test with a group of friends.

2. Elucidate the importance of non-verbal communication in making a presentation
3. Differentiate between kinesics, proxemics, and chronemics with examples.

Course Outcome 4 (CO4):

1. How can a participant conclude a group discussion effectively?
2. 'Listening skills are essential for effectively participating in a group discussion.' Do you agree? Substantiate your answer.

Course Outcome 5 (CO5):

1. Illustrate the creative thinking process with the help of a suitable example
2. Translate the following problem from verbal to graphic form and find the solution : *In a quiz, Ananth has 50 points more than Bimal, Chinmay has 60 points less than Ananth, and Dharini is 20 points ahead of Chinmay. What is the difference in points between Bimal and Dharini?*

3. List at least five ways in which the problem "How to increase profit?" can be redefined

Course Outcome 6 (CO6):

1. A group of engineers decided to brainstorm a design issue on a new product. Since no one wanted to disagree with the senior members, new ideas were not flowing freely. What group dynamics technique would you suggest to avoid this 'groupthink'? Explain the procedure.

2. “A group focuses on individual contribution, while a team must focus on synergy.” Explain.

3. Identify the type of group formed / constituted in each of the given situations

    a) A Police Inspector with subordinates reporting to him

    b) An enquiry committee constituted to investigate a specific incident

    c) The Accounts Department of a company

    d) A group of book lovers who meet to talk about reading

Syllabus

Module 1

Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress, coping with emotion.

Life skills for professionals: positive thinking, right attitude, attention to detail, having the big picture, learning skills, research skills, perseverance, setting goals and achieving them, helping others, leadership, motivation, self-motivation, and motivating others, personality development, IQ, EQ, and SQ

Module 2

Self-awareness: definition, need for self-awareness; Coping With Stress and Emotions, Human Values, tools and techniques of SA: questionnaires, journaling, reflective questions, meditation, mindfulness, psychometric tests, feedback.

Stress Management: Stress, reasons and effects, identifying stress, stress diaries, the four A's of stress management, techniques, Approaches: action-oriented, emotion-oriented, acceptance-oriented, resilience, Gratitude Training,

Coping with emotions: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method and relaxation techniques.

Morals, Values and Ethics: Integrity, Civic Virtue, Respect for Others, Living Peacefully. Caring, Sharing, Honesty, Courage, Valuing Time, Time management, Co operation, Commitment, Empathy, Self-Confidence, Character, Spirituality, Avoiding Procrastination, Sense of Engineering Ethics.

Module 3

21st century skills: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Steps in problem solving: Problem Solving Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Module 4

Group and Team Dynamics: Introduction to Groups: Composition, formation, Cycle, thinking, Clarifying expectations, Problem Solving, Consensus, Dynamics techniques, Group vs Team, Team Dynamics, Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5

Leadership: Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, turnaround leadership, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Lab Activities

Verbal

Effective communication and Presentation skills.
Different kinds of communication; Flow of communication; Communication networks, Types of barriers; Miscommunication
Introduction to presentations and group discussions.
Learning styles: visual, aural, verbal, kinaesthetic, logical, social, solitary; Previewing, KWL table, active listening, REAP method
Note-taking skills: outlining, non-linear note-taking methods, Cornell notes, three column note taking.
Memory techniques: mnemonics, association, flashcards, keywords, outlines, spider diagrams and mind maps, spaced repetition.
Time management: auditing, identifying time wasters, managing distractions, calendars and checklists; Prioritizing - Goal setting, SMART goals; Productivity tools and apps, Pomodoro technique.

Non Verbal:
Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language, Communication in a multi cultural environment.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, “Personality Development & Soft Skills”, Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, “The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership”, John Wiley & Sons, 2004.
5. Kalyana, “Soft Skill for Managers”; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, “The First Book of Life Skills”; First Edition, Embassy Books, 2016.
7. Shalini Verma, “Development of Life Skills and Professional Practice”; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, “Soft Skills for Everyone”, Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 edition, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.

PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati PrakashanPublishers, Revised Edition, 2009

2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008

3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014

4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

ESL 120	CIVIL & MECHANICAL WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
			0	0	2	1	2019

Preamble: The course is designed to train the students to identify and manage the tools, materials and methods required to execute an engineering project. Students will be introduced to a team working environment where they develop the necessary skills for planning, preparing and executing an engineering project.

To enable the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to:

Course Outcome	Course Outcome Description
CO 1	Name different devices and tools used for civil engineering measurements
CO 2	Explain the use of various tools and devices for various field measurements
CO 3	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
CO 4	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
CO 5	Compare different techniques and devices used in civil engineering measurements
CO 6	Identify Basic Mechanical workshop operations in accordance with the material and objects
CO 7	Apply appropriate Tools and Instruments with respect to the mechanical workshop trades
CO 8	Apply appropriate safety measures with respect to the mechanical workshop trades

<u>Mapping of course outcomes with program outcomes:</u>

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	1	1	-	-	2	2	-	-
CO 2	1	-	-	-	1	1	-	-	2	2	-	-
CO 3	1	-	-	-	1	1	-	2	2	2	1	-
CO 4	1	-	-	-	1	1	-	2	2	2	1	1
CO 5	1	-	-	-	1	1	-	-	2	2		1
CO 6	2											

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices

Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar

(b) Transfer the level from one point to another using a water level

(c) Set out a one room building with a given plan and measuring tape

Exercise 3. Find the level difference between any two points using dumpy level

Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.

(b) Estimate the number of different types of building blocks to construct this wall.

Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves ,fixtures and sanitary fittings.

(b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, “Indian Practical Civil Engineering Handbook”, Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, “Engineering Materials,” Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T –Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1.Bench Molding 2. Floor Molding 3. Core making 4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Dissembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	**INTRODUCTION**	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	**CARPENTRY**	
2.1	Understanding of carpentry tools and making minimum one model	2

3	**FOUNDRY**	
3.1	Understanding of foundry tools and making minimum one model	2
4	**SHEET METAL**	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	**FITTING**	
5.1	Understanding of fitting tools and making minimum one model	2
6	**PLUMBING**	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	**SMITHY**	
7.1	Understanding of smithy tools and making minimum one model	2
8	**WELDING**	
8.1	Understanding of welding equipments and making minimum one model	2
9	**ASSEMBLY**	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	**MACHINES**	
10.1	Demonstration of various machines	1
11	**MODERN MANUFACTURING METHODS**	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus

PART 1

ELECTRICAL

List of Exercises / Experiments

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

   b)Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications.

   b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II

ELECTRONICS

List of Exercises / Experiments (Minimum of 7 mandatory)

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or XCircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits).**

    1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
    2. Square wave generation using IC 555 timer in IC base.
    3. Sine wave generation using IC 741 OP-AMP in IC base.
    4. RC coupled amplifier with transistor BC107.

SEMESTER II

MAT 102	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: This course introduces the concepts and applications of differentiation and integration of vector valued functions, differential equations, Laplace and Fourier Transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions, ordinary differential equations and basic transforms such as Laplace and Fourier Transforms which are invaluable for any engineer's mathematical tool box. The topics treated in this course have applications in all branches of engineering.

Prerequisite: Calculus of single and multi variable functions.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the derivatives and line integrals of vector functions and learn their applications
CO 2	Evaluate surface and volume integrals and learn their inter-relations and applications.
CO 3	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients
CO 4	Compute Laplace transform and apply them to solve ODEs arising in engineering
CO 5	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	3	2	1			1	2		2
CO 2	3	3	3	3	2	1			1	2		2
CO 3	3	3	3	3	2	1			1	2		2
CO 4	3	3	3	3	2	1			1	2		2
CO 5	3	3	3	3	2	1			1	2		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks	Test 2 (Marks)	
Remember	10	10	20
Understand	20	20	40
Apply	20	20	40
Analyse			
Evaluate			

Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

Assignments: Assignment should include specific problems highlighting the applications of the methods introduced in this course in science and engineering.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time $t$is $\boldsymbol{r}(t)$?

2. Find the work done by the force field $F = (e^x - y^3)\boldsymbol{i} + (\cos y + x^3)$on a particle that travels once around the unit circle centred at origin having radius 1.

3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 2 (CO2): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.

2. Use the divergence theorem to find the outward flux of the vector field $F(x, y, z) = z\boldsymbol{k}$across the

$$x^2 + y^2 + z^2 = a^2$$

3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

Course Outcome 3 (CO3): Solve homogeneous and non-homogeneous linear differential equation with constant coefficients

1. If $y_1(x)$ and $y_2(x)$ are solutions of$y'' + py' + qy = 0$, where p, q are constants, show that

   $y_1(x) + y_2(x)$ is also a solution.

2. Solve the differential equation $y'' + y = 0.001x^2$ using method of undetermined coefficient.

3. Solve the differential equation of$y''' - 3y'' + 3y' - y = e^x - x - 1$.

Course Outcome 4 (CO4): Compute Laplace transform and apply them to solve ODEs arising in engineering

1. What is the inverse Laplace Transformof $(s) = \frac{3s-137}{s^2+2s+4}$?

2. Find Laplace Transform of Unit step function.

3. Solve the differential equation of $y'' + 9y = \delta\left(t - \frac{\pi}{2}\right)$? Given $y(0) = 2,\ y'(0) = 0$

Course Outcome 5(CO5): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering

1. Find the Fourier integral representation of function defined by $f(x) = e^{-x}$for$x > 0$ and $f(x) = 0$for$x < 0$.

2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?

3. Find the Fourier transform of $f(x) = 1$ for $|x| < 1$ and $f(x) = 0$ otherwise.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MAT 102

Max. Marks: 100 **Duration: 3 Hours**

VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS

(2019-Scheme)

(Common to all branches)

PART A

(Answer all questions. Each question carries 3 marks)

1. Is the vector $\boldsymbol{r}$ **where** $\boldsymbol{r} = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ conservative. Justify your answer.
2. State Greens theorem including all the required hypotheses
3. What is the outward flux of $\boldsymbol{F}(\boldsymbol{x},\boldsymbol{y},\boldsymbol{z}) = x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k}$ across any unit cube**.**
4. What is the relationship between Green's theorem and Stokes theorem?
5. Solve $y'' + 4y' + 2.5y = 0$
6. Does the function $y = C_1 \cos x + C_2\, sinx$form a solution of$y'' + y = 0$?. Is it the general solution? Justify your answer.
7. Find the Laplace transform of $e^{-t}\sinh 4t$
8. Find the Laplace inverse transform of $\frac{1}{s\,(s^2+\omega^2)}$.
9. Given the Fourier transform $\frac{1}{\sqrt{2}}e^{-\frac{\omega^2}{4}}$ of $f(x) = e^{-x^2}$, find the Fourier transform of xe^{-x^2}
10. State the convolution theorem for Fourier transform

PART B

(Answer one full question from each module. Each full question carries 14 marks)

MODULE 1

11a) Prove that the force field $\boldsymbol{F} = e^y\boldsymbol{i} + xe^y\boldsymbol{j}$is conservative in the entire xy-plane

b**)** Use Greens theorem to find the area enclosed by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

12 a) Find the divergence of the vector field$\boldsymbol{F} = \frac{c}{(x^2+y^2+z^2)^{3/2}}(x\boldsymbol{i} + y\boldsymbol{j} + z\boldsymbol{k})$

b) Find the work done by the force field$\boldsymbol{F}(x,y,z) = xy\boldsymbol{i} + yz\boldsymbol{j} + xz\boldsymbol{k}$along C where

C is the curve$\boldsymbol{r}(t) = t\boldsymbol{i} + t^2\boldsymbol{j} + t^3\boldsymbol{k}$

MODULE II

13 a) Use divergence theorem to find the outward flux of the vector field

$\boldsymbol{F} = 2x\boldsymbol{i} + 3y\boldsymbol{j} + z^3\boldsymbol{k}$acrossthe unit cube bounded by or $x = 0$, $y = 0, z = 0, x = 1, y = 1, z = 1$

b) Find the circulation of $\boldsymbol{F} = (x - z)\boldsymbol{i} + (y - x)\boldsymbol{j} + (\boldsymbol{z} - \boldsymbol{xy})\boldsymbol{k}$ using Stokes theorem around the triangle with vertices $A(1,0,0)$, $B(0,2,0)$and $C(0,0,1)$

14 a**)** Use divergence theorem to find the volume of the cylindrical solid bounded by $x^2 + 4x + y^2 = 7$, $z = -1$, $z = 4$, given the vector field $\boldsymbol{F} = \boldsymbol{x}i + \boldsymbol{y}j + \boldsymbol{z}k$ across surfaceof the cylinder

b) Use Stokes theorem to evaluate$\int_C \boldsymbol{F}.\boldsymbol{dr}$where$\boldsymbol{F} = x^2\boldsymbol{i} + 3x\boldsymbol{j} - y^3\boldsymbol{k}$where Cis the circle $x^2 + y^2 = 1$ in the xy- plane with counterclockwise orientation looking down the positive z-axis

MODULE III

15 a) Solve $y'' + 4y' + 4y = x^2 + e^{-x}\cos x$

b) Solve $y''' - 3y'' + 3y' - y = e^x - x - 1$

16 a) Solve $\boldsymbol{y'''} + \boldsymbol{3}y'' + 3y' + y = 30e^{-x}$ given $y(0) = 3, y'(0) = -3$ **,** $y''(0) = -47$

b) Using method of variation of parameters, solve $y'' + y = sec\ x$

MODULE IV

17 a) Find the inverse Laplace transform of $F(s) = \frac{2(e^{-s} - e^{-3s})}{s^2 - 4}$

b) Solve the differential equation $y'' + 16y = 4\delta(t - 3\pi)$; $y(0) = 2, y'(0) = 0$ using Laplace transform

18 a) Solve $y'' + 3y' + 2y = f(t)$ where $f(t) = 1$ for $0 < t < 1$ and $f(t) = 1$ for $t > 1$ using Laplace transform

b) Apply convolution theorem to find the Laplace inverse transform of $\frac{1}{s^2(s^2+\omega^2)}$

MODULE V

19 a) Find the Fourier cosine integral representation for $f(x) = e^{-kx}$ for $x > 0$ and $k > 0$ and hence evaluate $\int_0^\infty \frac{\cos wx}{k^2+w^2}$ the function

b) Does the Fourier sine transform $f(x) = x^{-1}\sin x$ for $0 < x < \infty$ exist? Justify your answer

20 a) Find the Fourier transform of $f(x) = |x|$ for $|x| < 1$ and $f(x) = 0$ otherwise

b) Find the Fourier cosine transform of $f(x) = e^{-ax}$ for a> 0

Syllabus

Module 1 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields , Gradient and its properties, directional derivative , divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields , independence of path and potential function(results without proof).

Module 2 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z) , Flux integrals over surfaces of the form z = g(x, y), y = g(x, z) or x = g(y, z), divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Module- 3 (Ordinary differential equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5, 2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle,general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only).Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients (for the right hand side of the form x^n,e^{kx},$sinax$,$cosax$,$e^{kx}sinaxe^{kx}cosax$and their linear combinations), methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficient using method of undetermined coefficient.

Module- 4 (Laplace transforms)

(Text 2: Relevant topics from sections 6.1,6.2,6.3,6.4,6.5)

Laplace Transform and its inverse ,Existence theorem (without proof) , linearity,Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorems. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem(without proof)and its application to finding inverse Laplace transform of products of functions.

Module-5 (Fourier Tranforms)

(Text 2: Relevant topics from sections 11.7,11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof)

Text Books

1. H. Anton, I. Biven S.Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th edition, 2015.

Reference Books

1. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9 th Edition, Pearson,Reprint, 2002.
3. Peter O Neil, Advanced Engineering Mathematics, 7th Edition, Thomson, 2007.
4. Louis C Barret, C Ray Wylie, "Advanced Engineering Mathematics", Tata McGraw Hill, 6th edition, 2003.
5. VeerarajanT."Engineering Mathematics for first year", Tata McGraw - Hill, 2008.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th edition , 2010.
7. Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, 2015.
8. Ronald N. Bracewell, "The Fourier Transform and its Applications", McGraw – Hill International Editions, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Calculus of vector functions** (**9 hours**)	
1.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
1.2	Motion along a curve-speed , velocity, acceleration	1
1.3	Gradient and its properties, directional derivative , divergent and curl	3
1.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
1.5	Conservative vector field, independence of path, potential function	1

2	**Vector integral theorems(9 hours)**	
2.1	Green's theorem and it's applications	2
2.2	Surface integrals , flux integral and their evaluation	3
2.3	Divergence theorem and applications	2
2.4	Stokes theorem and applications	2
3	**Ordinary Differential Equations (9 hours)**	
3.1	Homogenous linear equation of second order, Superposition principle, general solution	1
3.2	Homogenous linear ODEs of second order with constant coefficients	2
3.3	Second order Euler-Cauchy equation	1
3.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
3.5	Higher order equations with constant coefficients	2
4	**Laplace Transform (10 hours)**	
4.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions	2
4.2	Transform of derivatives and integrals	1
4.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
4.4	Unit step function --- Second shifting theorem	2
4.5	Dirac Delta function and solution of ODE involving Dirac delta function	2
4.6	Convolution and related problems.	1
5	**Fourier Transform (8 hours)**	
5.1	Fourier integral representation	1
5.2	Fourier Cosine and Sine integrals and transforms	2
5.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties	3
5.4	Fourier transform of derivatives, Convolution theorem	2

PHT 100	ENGINEERING PHYSICS A (FOR CIRCUIT BRANCHES)	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics Program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Classify the properties of magnetic materials and apply vector calculus to static magnetic fields and use Maxwell's equations to diverse engineering problems
CO 5	Analyze the principles behind various superconducting applications, explain the working of solid state lighting devices and fibre optic communication system

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3	1						1	2			1
CO 5	3	1						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.

2. Distinguish between transverse and longitudinal waves.

3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.

   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.

2. Distinguish between Fresnel and Fraunhofer diffraction.

3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.

   (b) A liquid of refractive index μ is introduced between the lens and glass plate.

What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function ?

2. What are excitons ?

3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.

   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Compare displacement current and conduction current.

2. Mention any four properties of ferro magnetic materials.

3. (a) Starting from Maxwell's equations, derive the free space electromagnetic wave equation and show that velocity of electromagnetic wave is $1/(\mu_o \varepsilon_o)^{1/2}$

   (b) An electromagnetic wave is described by $E = 100 \exp 8\pi i [10^{14} t - (10^{6} z / 3)]$ V/m. Find the direction of propagation of the wave,speed of the wave and magnetic flux density in the wave.

Course Outcome 5 (CO5):

1. Explain the working of a solar cell.

2. Distinguish between Type I and Type II super conductors.

3. (a) Define numerical aperture and derive an expression for it.

   (b) Explain the working of intensity modulated fibre optic sensor.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 100

Course Name: Engineering Physics A

Max. Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators

2. Distinguish between longitudinal and transverse waves

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. State Faraday's laws of electromagnetic induction.

8. Compare displacement current and conduction current

9. List four important applications of superconductors.

10. Give the working principle of LED. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution.Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value.(4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t)m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv)Velocity of the wave. (4)

Module 2

13.(a)Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid. (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15.(a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16.(a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17.(a) State Poynting's Theorem. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is 3.8 x 10^{26} W and its radius is 7 X 10^{8} m. (5)

(b) Distinguish between paramagnetic, diamagnetic and ferromagnetic materials. (9)

18.(a) Starting from Maxwell's Equations, derive electromagnetic wave equations in free space. (10)

(b) If the magnitude of **H** in a plane wave is 1 A/m, find the magnitude of **E** in free space. (4)

Module 5

19.(a) Show that superconductors are perfect diamagnets. Distinguish between Type I and Type II superconductors with suitable examples. (10)

(b) Write a short note on high temperature superconductors. (4)

20.(a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33. (4)

(14x5=70)

Syllabus

ENGINEERING PHYSICS A
(FOR CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Magnetism & Electro Magnetic Theory

Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux, Magnetic permeability and susceptibility, Classification of magnetic materials-para, dia and ferromagnetic materials

Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem, Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)

Module 5

Superconductivity & Photonics

Superconducting phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II, BCS Theory (Qualitative), High temperature superconductors-Applications of super conductivity

Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics, Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors.

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition 2019

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition 2017

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. Halliday, Resnick, Walker, "Fundamentals of Physics'', John Wiley & Sons.Inc, 2001
8. David J Griffiths, "Introduction to Electrodynamics'', Addison-Wesley publishing, 3rd Edition, 1999
9. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition,2017
10. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves. Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hr
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Magnetism & Electro Magnetic Theory (9 hours)**	
4.1	Magnetic field and Magnetic flux density, Gauss's law for Magnetic flux	2 hrs

	density, Ampere's Circuital law, Faraday's law in terms of EMF produced by changing magnetic flux	
4.2	Explanation for Magnetic permeability and susceptibility Classification of magnetic materials- para, dia and ferromagnetic materials	1 hr
4.3	Fundamentals of vector calculus, concept of divergence, gradient and curl along with physical significance, Line, Surface and Volume integrals, Gauss divergence theorem & Stokes' theorem	2 hrs
4.4	Equation of continuity, Derivation of Maxwell's equations in vacuum, Comparison of displacement current with conduction current. Electromagnetic waves, Velocity of Electromagnetic waves in free space, Flow of energy and Poynting's vector (no derivation)	4 hrs
5	**Superconductivity &Photonics (9hours)**	
5.1	Super conducting Phenomena, Meissner effect and perfect diamagnetism, Types of superconductors-Type I and Type II	2 hrs
5.2	BCS Theory (Qualitative), High temperature superconductors, Applications of super conductivity	2 hrs
5.3	Introduction to photonics-Photonic devices-Light Emitting Diode, Photo detectors -Junction and PIN photodiodes, Solar cells-I-V Characteristics	2 hrs
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications of optical fibre, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

PHT 110	ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)	Category	L	T	P	CREDIT	Year of Introduction
		BSC	3	1	0	4	2019

Preamble: The aim of the Engineering Physics program is to offer students a solid background in the fundamentals of Physics and to impart that knowledge in engineering disciplines. The program is designed to develop scientific attitudes and enable the students to correlate the concepts of Physics with the core programmes

Prerequisite: Higher secondary level Physics, Mathematical course on vector calculus, differential equations and linear algebra

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the quantitative aspects of waves and oscillations in engineering systems.
CO 2	Apply the interaction of light with matter through interference, diffraction and identify these phenomena in different natural optical processes and optical instruments.
CO 3	Analyze the behaviour of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices.
CO 4	Apply the knowledge of ultrasonics in non-destructive testing and use the principles of acoustics to explain the nature and characterization of acoustic design and to provide a safe and healthy environment
CO 5	Apply the comprehended knowledge about laser and fibre optic communication systems in various engineering applications

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2						1	2			1
CO 2	3	2						1	2			1
CO 3	3	2						1	2			1
CO 4	3							1	2			1
CO 5	3	2						1	2			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	15	15	30
Understand	25	25	50

Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE MARKS	ESE MARKS	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Explain the effect of damping force on oscillators.
2. Distinguish between transverse and longitudinal waves.
3. (a) Derive an expression for the fundamental frequency of transverse vibration in a stretched string.
   (b) Calculate the fundamental frequency of a string of length 2 m weighing 6 g kept stretched by a load of 600 kg.

Course Outcome 2 (CO2):

1. Explain colours in thin films.
2. Distinguish between Fresnel and Fraunhofer diffraction.
3. (a) Explain the formation of Newton's rings and obtain the expression for radii of bright and dark rings in reflected system. Also explain how it is used to determine the wavelength of a monochromatic source of light.
   (b) A liquid of refractive index μ is introduced between the lens and glass plate. What happens to the fringe system? Justify your answer.

Course Outcome 3 (CO3):

1. Give the physical significance of wave function?

2. What are excitons ?
3. (a) Solve Schrodinger equation for a particle in a one dimensional box and obtain its energy eigen values and normalised wave functions.
   (b) Calculate the first three energy values of an electron in a one dimensional box of width 1 A^0 in electron volt.

Course Outcome 4 (CO4):

1. Explain reverberation and reverberation time.
2. How ultrasonic waves are used in non-destructive testing.
3. (a) With a neat diagram explain how ultrasonic waves are produced by a piezoelectric oscillator.
   (b) Calculate frequency of ultrasonic waves that can be produced by a nickel rod of length 4 cm. (Young's Modulus = 207 G Pa, Density = 8900 Kg /m^3)

Course Outcome 5 (CO 5):

1. Distinguish between spontaneous emission and stimulated emission.
2. Explain optical resonators.
3. (a) Explain the construction and working of Ruby Laser.
   (b) Calculate the numerical aperture and acceptance angle of a fibre with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fibre is inside water of refractive index 1.33.

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Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: PHT 110

Course Name: Engineering Physics B

Max.Marks: 100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Compare electrical and mechanical oscillators.

2. Distinguish between longitudinal and transverse waves.

3. Write a short note on antireflection coating.

4. Diffraction of light is not as evident in daily experience as that of sound waves. Give reason.

5. State and explain Heisenberg's Uncertainty principle. With the help of it explain natural line broadening.

6. Explain surface to volume ratio of nanomaterials.

7. Define sound intensity level. Give the values of threshold of hearing and threshold of pain.

8. Describe the method of non-destructive testing using ultra sonic waves

9. Explain the condition of population inversion

10. Distinguish between step index and graded index fibre. (10x3=30)

PART B

Answer any one full question from each module. Each question carries 14 Marks

Module 1

11. (a) Derive the differential equation of damped harmonic oscillator and deduce its solution. Discuss the cases of over damped, critically damped and under damped cases. (10)

(b) The frequency of a tuning fork is 500 Hz and its Q factor is 7×10^{4}. Find the relaxation time. Also calculate the time after which its energy becomes 1/10 of its initial undamped value. (4)

12. (a) Derive an expression for the velocity of propagation of a transverse wave in a stretched string. Deduce laws of transverse vibrations. (10)

(b) The equation of transverse vibration of a stretched string is given by y =0.00327 sin (72.1x-2.72t) m, in which the numerical constants are in S.I units. Evaluate (i) Amplitude (ii) Wavelength (iii) Frequency and (iv) Velocity of the wave. (4)

Module 2

13. (a) Explain the formation of Newton's rings and show that the radius of dark ring is proportional to the square root of natural numbers. How can we use Newton's rings experiment to determine the refractive index of a liquid? (10)

(b) Two pieces of plane glass are placed together with a piece of paper between two at one end. Find the angle of the wedge in seconds if the film is viewed with a monochromatic light of wavelength 4800Å. Given β = 0.0555 cm. (4)

14. (a) Explain the diffraction due to a plane transmission grating. Obtain the grating equation. (10)

(b) A grating has 6000 lines per cm. Find the angular separation of the two yellow lines of mercury of wavelengths 577 nm and 579 nm in the second order. (4)

Module 3

15. (a) Derive time dependent and independent Schrodinger equations. (10)

(b) An electron is confined to one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. (4)

16. (a) Classify nanomaterials based on dimensionality of quantum confinement and explain the following nanostructures. (i) nano sheets (ii) nano wires (iii) quantum dots. (10)

(b) Find the de Broglie wavelength of electron whose kinetic energy is 15 eV. (4)

Module 4

17. (a) Explain reverberation and reverberation time? What is the significance of Reverberation time. Explain the factors affecting the acoustics of a building and their corrective measures? (10)

(b) The volume of a hall is 3000 m^3. It has a total absorption of 100m^2 sabine. If the hall is filled with audience who add another 80 m^2sabine, then find the difference in reverberation time. (4)

18. (a) With a neat diagram explain how ultrasonic waves are produced by piezoelectric oscillator. Also discuss the piezoelectric method of detection of ultrasonic waves. (10)

(b) An ultrasonic source of 0.09 MHz sends down a pulse towards the sea bed which returns after 0.55 sec. The velocity of sound in sea water is 1800 m/s. Calculate the depth of the sea and the wavelength of the pulse. (4)

Module 5

19. (a) Outline the construction and working of Ruby laser. (8)

(b) What is the principle of holography? How is a hologram recorded? (6)

20. (a) Define numerical aperture of an optic fibre and derive an expression for the NA of a step index fibre with a neat diagram. (10)

(b) An optical fibre made with core of refractive index 1.5 and cladding with a fractional index difference of 0.0006. Find refractive index of cladding and numerical aperture. (4)

(14x5=70)

SYLLABUS

ENGINEERING PHYSICS B (FOR NON-CIRCUIT BRANCHES)

Module 1

Oscillations and Waves

Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression, Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators

Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation), Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration

Module 2

Wave Optics

Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference, Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings

Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation, Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)

Module 3

Quantum Mechanics & Nanotechnology

Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening Mechanism, Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)

Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots, Properties of nanomaterials-mechanical, electrical and optical, Applications of nanotechnology (qualitative ideas)

Module 4

Acoustics & Ultrasonics

Acoustics, Classification of sound-Musical sound-Noise, Characteristics of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine's formula (no derivation), Factors affecting architectural acoustics and their remedies

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator –Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods, Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid , Applications of ultrasonic waves -SONAR,NDT and Medical

Module 5

Laser and Fibre optics

Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein's coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle, Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) ,Applications of laser, Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications

Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors

Text Books

1. M.N.Avadhanulu, P.G.Kshirsagar,TVS Arun Murthy "A Text book of Engineering Physics", S.Chand &Co., Revised Edition, 2019.

2. H.K.Malik , A.K. Singh, "Engineering Physics" McGraw Hill Education, Second Edition, 2017.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015
5. Ajoy Ghatak, "Optics", Mc Graw Hill Education, Sixth Edition, 2017
6. T. Pradeep, "Nano:The Essentials'', McGraw Hill India Ltd, 2007
7. B. B. Laud, "Lasers and Non linear optics", New age International Publishers, 2nd Edition ,2005
8. Premlet B., "Advanced Engineering Physics", Phasor Books,10th edition ,2017
9. I. Dominic and. A. Nahari, "A Text Book of Engineering physics", Owl Books Publishers, Revised edition, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Oscillations and Waves (9 hours)**	
1.1	Harmonic oscillations, Damped harmonic motion-Derivation of differential equation and its solution, Over damped, Critically damped and Under damped Cases, Quality factor-Expression	2 hrs
1.2	Forced oscillations-Differential Equation-Derivation of expressions for amplitude and phase of forced oscillations, Amplitude Resonance-Expression for Resonant frequency, Quality factor and Sharpness of Resonance, Electrical analogy of mechanical oscillators	3hrs
1.3	Wave motion- Derivation of one dimensional wave equation and its solution, Three dimensional wave equation and its solution (no derivation)	2 hrs
1.4	Distinction between transverse and longitudinal waves, Transverse vibration in a stretched string, Statement of laws of vibration	2 hrs
2	**Wave Optics (9 hours)**	
2.1	Interference of light-Principle of superposition of waves, Theory of thin films - Cosine law (Reflected system), Derivation of the conditions of constructive and destructive Interference	2 hrs
2.2	Interference due to wedge shaped films -Determination of thickness and test for optical planeness, Newton's rings - Measurement of wavelength and refractive index, Antireflection coatings	4 hrs
2.3	Diffraction of light, Fresnel and Fraunhofer classes of diffraction, Diffraction grating-Grating equation	2 hrs
2.4	Rayleigh criterion for limit of resolution, Resolving and Dispersive power of a grating with expression (no derivation)	1 hr
3	**Quantum Mechanics &Nanotechnology (9hours)**	
3.1	Introduction for the need of Quantum mechanics, Wave nature of Particles, Uncertainty principle, Applications-Absence of electrons inside a nucleus and Natural line broadening mechanism	2 hrs
3.2	Formulation of time dependent and independent Schrodinger wave equations-Physical Meaning of wave function, Particle in a one dimensional box- Derivation for normalised wave function and energy eigen values, Quantum Mechanical Tunnelling (Qualitative)	4 hrs
3.3	Introduction to nanoscience and technology, Increase in surface to volume ratio for nanomaterials, Quantum confinement in one dimension, two dimension and three dimension-Nano sheets, Nano wires and Quantum dots	2 hrs
3.4	Properties of nanomaterials-mechanical, electrical and optical Applications of nanotechnology (qualitative ideas)	1 hr
4	**Acoustics & Ultrasonics (9hrs)**	
4.1	Acoustics, Classification of sound-Musical sound-Noise, Characteristics	3 hrs

	of Musical Sounds-Pitch or frequency-Loudness or Intensity-Measurement of Intensity level-Decibel-Quality or timbre, Absorption coefficient, Reverberation-Reverberation time-Significance- Sabine’s formula (no derivation)	
4.2	Factors affecting architectural acoustics and their remedies	1 hr
4.3	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Detection of ultrasonic waves - Thermal and Piezoelectric methods	3hrs
4.4	Ultrasonic diffractometer- Expression for the velocity of ultrasonic waves in a liquid ,Applications of ultrasonic waves -SONAR,NDT and Medical.	2 hr
5	**Laser and Fibre optics (9hours)**	
5.1	Properties of laser, Absorption and emission of radiation, Spontaneous and stimulated emission, Einstein’s coefficients (no derivation), Population inversion, Metastable states, basic components of laser, Active medium, Pumping mechanism, Optical resonant cavity, working principle	2 hrs
5.2	Construction and working of Ruby laser and Helium neon laser ,Construction and working of semiconductor laser(Qualitative) Applications of laser	3 hrs
5.3	Holography, Difference between hologram and photograph, Recording of hologram and reconstruction of image, Applications	1 hr
5.4	Optic fibre-Principle of propagation of light, Types of fibres-Step index and Graded index fibres, Numerical aperture –Derivation, Fibre optic communication system (block diagram), Industrial, Medical and Technological applications, Fibre optic sensors-Intensity Modulated and Phase modulated sensors	3 hrs

CYT 100	ENGINEERING CHEMISTRY	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	3	1	0	4	2019

Preamble: To enable the students to acquire knowledge in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like spectroscopy, electrochemistry, instrumental methods etc. Also familiarize the students with topics like mechanism of corrosion, corrosion prevention methods, SEM, stereochemistry, polymers, desalination etc., which enable them to develop abilities and skills that are relevant to the study and practice of chemistry.

Prerequisite: Concepts of chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Apply the basic concepts of electrochemistry and corrosion to explore its possible applications in various engineering fields.
CO 2	Understand various spectroscopic techniques like UV-Visible, IR, NMR and its applications.
CO 3	Apply the knowledge of analytical method for characterizing a chemical mixture or a compound. Understand the basic concept of SEM for surface characterisation of nanomaterials.
CO 4	Learn about the basics of stereochemistry and its application. Apply the knowledge of conducting polymers and advanced polymers in engineering.
CO 5	Study various types of water treatment methods to develop skills for treating wastewater.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	2	1									
CO 2	1	1		1	2							
CO 3	1	1		1	2							
CO 4	2	1										
CO 5	1			1			3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	20
Analyse			
Evaluate			
Create			

End Semester Examination Pattern: There will be two parts- **Part A** and **Part B. Part A** contains **10** questions (**2** questions from each module), having **3** marks for each question. Students should answer **all** questions. **Part B** contains **2** questions from each module, of which student should answer any one. Each question can have maximum **2** subdivisions and carries **14** marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1):

1. What is calomel electrode? Give the reduction reaction (3 Marks)

2. List three important advantages of potentiometric titration (3 Marks)

3. (a) Explain how electroless plating copper and nickel are carried out (10 Marks)

(b) Calculate the emf of the following cell at 30^{o}C, Z n / Zn $^{2+}$ (0.1M) // Ag^{+} (0.01M) // Ag.

Given E^{0} Zn^{2+}/Zn = -0.76 V, E^{0} Ag^{+}/Ag = 0.8 V. (4 Marks)

Course Outcome 2 (CO 2)

1. State Beer Lambert's law (3 Marks)

2. List the important applications of IR spectroscopy (3 Marks)

3. (a) What is Chemical shift? What are factors affecting Chemical shift? How ^{1}H NMR spectrum of CH_3COCH_2Cl interpreted using the concept of chemical shift. (10 Marks)

(b) Calculate the force constant of HF molecule, if it shows IR absorption at 4138 cm^{-1}. Given that atomic masses of hydrogen and fluorine are 1u and 19u respectively. (4 Marks)

Course Outcome 3 (CO 3):

1. Distinguish between TGA and DTA (3 Marks)

2. Give two differences between GSC and GLC (3 Marks)

3. (a) Explain the principle, instrumentation and procedure of HPLC (10 Marks)

(b) Interpret TGA of $CaC_2O_4.H_2O$ (4 Marks)

Course Outcome 4 (CO 4):

1. Explain the geometrical isomerism in double bonds (3 Marks)

2. What are the rules of assigning R-S notation? (3 Marks)

3. (a) What are conducting polymers? How it is classified? Give the preparation of polyaniline (10 Marks)

(b) Draw the stereoisomers possible for CH_3-$(CHOH)_2$-COOH (4 Marks)

Course Outcome 5 (CO 5):

1. What is degree of hardness? (3 Marks)

2. Define BOD and COD (3 Marks)

3. (a) Explain the EDTA estimation of hardness (10 Marks)

(b) Standard hard water contains 20 g of CaCO3 per liter,50 mL of this required 30mL of EDTA solution, 50mL of sample water required 20mL of EDTA solution. 50mL sample water after boiling required 14 mL EDTA solution. Calculate the temporary hardness of the given sample of water, in terms of ppm. (4 Marks)

MODEL QUESTION PAPER

Total Pages:

Reg No.:________________ Name:____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER B.TECH DEGREE EXAMINATION

Course Code: CYT100,

Course Name: ENGINEERING CHEMISTRY

Max. Marks: 100 Duration: 3 Hours

PART A

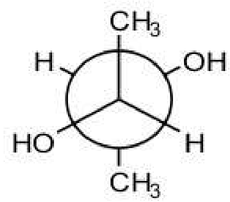
Answer all questions, each carries 3 marks Marks

1	What is potentiometric titration? How the end point is determined graphically?	(3)
2	What is Galvanic series? How is it different from electrochemical series?	(3)
3	Which of the following molecules can give IR absorption? Give reason? (a) O_2 (b) H_2O (c) N_2 (d) HCl	(3)
4	Which of the following molecules show UV-Visible absorption? Give reason. (a) Ethane (b) Butadiene (c) Benzene	(3)

5 What are the visualization techniques used in TLC? (3)

6 Write the three important applications of nanomaterials. (3)

7 Draw the Fischer projection formula and find R-S notation of (3)



8 Write the structure of a) Polypyrroleb) Kevlar. (3

9 What is break point chlorination? (3)

10 What is reverse osmosis? (3)

PART B

Answer any one full question from each module, each question carries 14 marks

Module 1

11 a) Give the construction of Li-ion cell. Give the reactions that take place at the electrodes during charging and discharging. What happens to anodic material when the cell is 100% charged. (10)

b) Calculate the standard electrode potential of Cu, if its electrode potential at 25 °C is 0.296 V and the concentration of Cu^{2+} is 0.015 M. (4)

OR

12 a) Explain the mechanism of electrochemical corrosion of iron in oxygen rich and oxygen deficient acidic and basic environments. (10)

b) Given below are reduction potentials of some species (4)

$MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$; $E^0 = +1.51$ V

$Cl_2 + 2e \rightarrow 2Cl^-$; $E^0 = +1.36$ V

$S_2O_8^{2-} + 2e \rightarrow 2SO_4^{2-}$; $E^0 = +1.98$ V

Use the above data to examine whether the acids, dil. HCl and dil. H_2SO_4 , can be used to provide acid medium in redox titrations involving $KMnO_4$.

Module 2

13 a) What is spin-spin splitting? Draw the NMR spectrum of (i) CH_3 CH_2CH_2 Br (ii) $CH_3CH(Br)CH_3$ Explain how NMR spectrum can be used to identify the two isomers. (10)

b) A dye solution of concentration 0.08M shows absorbance of 0.012 at 600 nm; while a test solution of same dye shows absorbance of 0.084 under same conditions. Find the concentration of the test solution. (4)

OR

14 a) Explain the basic principle of UV-Visible spectroscopy. What are the possible electronic transitions? Explain with examples. (10)

b) Sketch the vibrational modes of CO_2 and H_2O. Which of them are IR active? (4)

Module 3

15	a)	Explain the principle, instrumentation and procedure involved in gas chromatography.	(10)
	b)	Explain the DTA of $CaC_2O_4.H_2O$ with a neat sketch.	(4)

OR

16	a)	Explain the various chemical methods used for the synthesis of nanomaterial	(10)
	b)	How TGA is used to analyse the thermal stability of polymers?	(4)

Module 4

17	a)	What are conformers? Draw the*cis* and *trans*isomers of 1, 3-dimethylcylohexane. Which conformer (chair form) is more stable in each case?	(10)
	b)	What is ABS? Give properties and applications.	(4)

OR

18	a)	Explain the various structural isomers with suitable example.	(10)
	b)	What is OLED? Draw a labelled diagram.	(4)

Module 5

19	a)	What are ion exchange resins? Explain ion exchange process for removal of hardness of water? How exhausted resins are regenerated?	(10)
	b)	50 mL sewage water is diluted to 2000 mL with dilution water; the initial dissolved oxygen was 7.7 ppm. The dissolved oxygen level after 5 days of incubation was 2.4 ppm. Find the BOD of the sewage.	(4)

OR

20	a)	What are the different steps in sewage treatment? Give the flow diagram. Explain the working of trickling filter.	(10)
	b)	Calculate the temporary and permanent hardness of a water sample which contains $[Ca^{2+}]$ = 160 mg/L, $[Mg^{2+}]$ = 192 mg/L and $[HCO_3^-]$ = 122 mg/L.	(4)

Syllabus

Module 1

Electrochemistry and Corrosion

Introduction - Differences between electrolytic and electrochemical cells - Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes - SHE - Calomel electrode - Glass Electrode - Construction and Working. Single electrode potential - definition - Helmholtz electrical double layer -Determination of E^0 using calomel electrode.Determination of pH using glass electrode.Electrochemical series and its applications. Free energy and EMF - Nernst Equation - Derivation - single electrode and cell (Numericals) -Application - Variation of emf with temperature. Potentiometric titration - Introduction -Redox titration only.Lithiumion cell - construction and working.Conductivity- Measurement of conductivity of a solution (Numericals).

Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.

Module 2

Spectroscopic Techniques and Applications

Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert's law (Numericals). UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.IR-Spectroscopy – Principle - Number of vibrational modes - Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications. ^{1}H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).

Module 3

Instrumental Methods and Nanomaterials

Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$. Chromatographic methods - Basic principles and applications of column and TLC-Retention factor. GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.

Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).

Module 4

Stereochemistry and Polymer Chemistry

Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations). R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.

Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications.Kevlar-preparation, properties and applications.Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.

Module 5

Water Chemistry and Sewage Water Treatment

Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages. Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.

Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals). Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram -Trickling filter and UASB process.

Text Books

1. B. L. Tembe, Kamaluddin, M. S. Krishnan, "Engineering Chemistry (NPTEL Web-book)", 2018.

2. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.

Reference Books

1. C. N. Banwell, "Fundamentals of Molecular Spectroscopy", McGraw-Hill, 4th edn., 1995.
2. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.
3. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.
4. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
5. Ernest L. Eliel, Samuel H. Wilen, "Stereo-chemistry of Organic Compounds", WILEY, 2008.
6. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
7. MuhammedArif, Annette Fernandez, Kavitha P. Nair "Engineering Chemistry", Owl Books, 2019.
8. Ahad J., "Engineering Chemistry", Jai Publication, 2019.
9. Roy K. Varghese, "Engineering Chemistry", Crownplus Publishers, 2019.
10. Soney C. George,RinoLaly Jose, "Text Book of Engineering Chemistry", S. Chand & Company Pvt Ltd, 2019.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures (hrs)
1	**Electrochemistry and Corrosion**	9
1.1	Introduction - Differences between electrolytic and electrochemical cells- Daniel cell - redox reactions - cell representation. Different types of electrodes (brief) - Reference electrodes- SHE - Calomel electrode - Glass Electrode - Construction and Working.	2
1.2	Single electrode potential – definition - Helmholtz electrical double layer - Determination of E^0 using calomel electrode. Determination of pH using glass electrode. Electrochemical series and its applications. Free energy and EMF - Nernst Equation – Derivation - single electrode and cell (Numericals) -Application -Variation of emf with temperature.	3
1.3	Potentiometric titration - Introduction -Redox titration only. Lithiumion cell - construction and working. Conductivity- Measurement of conductivity of a solution (Numericals).	2
1.4	Corrosion-Electrochemicalcorrosion – mechanism. Galvanic series- cathodic protection - electroless plating –Copper and Nickel plating.	2
2	**Spectroscopic Techniques and Applications**	9
2.1	Introduction- Types of spectrum - electromagnetic spectrum - molecular energy levels - Beer Lambert’s law (Numericals).	2
2.2	UV-Visible Spectroscopy – Principle - Types of electronic transitions - Energy level diagram of ethane, butadiene, benzene and hexatriene. Instrumentation of UV-Visible spectrometer and applications.	2
2.3	IR-Spectroscopy – Principle - Number of vibrational modes -Vibrational energy states of a diatomic molecule and -Determination of force constant of diatomic molecule (Numericals) –Applications.	2
2.4	^1H NMR spectroscopy – Principle - Relation between field strength and frequency - chemical shift - spin-spin splitting (spectral problems) - coupling constant (definition) - applications of NMR- including MRI (brief).	3
3	**Instrumental Methods and Nanomaterials**	9
3.1	Thermal analysis –TGA- Principle, instrumentation (block diagram) and applications – TGA of $CaC_2O_4.H_2O$ and polymers. DTA-Principle, instrumentation (block diagram) and applications - DTA of $CaC_2O_4.H_2O$.	2

3.2	Chromatographic methods - Basic principles and applications of column and TLC-Retention factor.	**2**
3.3	GC and HPLC-Principle, instrumentation (block diagram) - retention time and applications.	**2**
3.4	Nanomaterials - Definition - Classification - Chemical methods of preparation - Hydrolysis and Reduction - Applications of nanomaterials - Surface characterisation -SEM – Principle and instrumentation (block diagram).	**3**
4	**Stereochemistry and Polymer Chemistry**	**9**
4.1	Isomerism-Structural, chain, position, functional, tautomerism and matamerism - Definition with examples - Representation of 3D structures-Newman, Sawhorse, Wedge and Fischer projection of substituted methane and ethane. Stereoisomerism - Geometrical isomerism in double bonds and cycloalkanes (cis-trans and E-Z notations).	**2**
4.2	R-S Notation – Rules and examples - Optical isomerism, Chirality, Enantiomers and Diastereoisomers-Definition with examples.	**1**
4.3	Conformational analysis of ethane, butane, cyclohexane, mono and di methyl substituted cyclohexane.	**2**
4.4	Copolymers - Definition - Types - Random, Alternating, Block and Graft copolymers - ABS - preparation, properties and applications. Kevlar-preparation, properties and applications. Conducting polymers - Doping -Polyaniline and Polypyrrole - preparation properties and applications. OLED - Principle, construction and advantages.	**4**
5	**Water Chemistry and Sewage Water Treatment**	**9**
5.1	Water characteristics - Hardness - Types of hardness- Temporary and Permanent - Disadvantages of hard water -Units of hardness- ppm and mg/L -Degree of hardness (Numericals) - Estimation of hardness-EDTA method (Numericals). Water softening methods-Ion exchange process-Principle, procedure and advantages. Reverse osmosis – principle, process and advantages.	**3**
5.2	Municipal water treatment (brief) - Disinfection methods - chlorination, ozone andUV irradiation.	**2**
5.3	Dissolved oxygen (DO) -Estimation (only brief procedure-Winkler's method), BOD and COD-definition, estimation (only brief procedure) and significance (Numericals).	**2**
5.4	Sewage water treatment - Primary, Secondary and Tertiary - Flow diagram - Trickling filter and UASB process.	**2**

EST 100	ENGINEERING MECHANICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	1	0	3	2019

Preamble: Goal of this course is to expose the students to the fundamental concepts of mechanics and enhance their problem-solving skills. It introduces students to the influence of applied force system and the geometrical properties of the rigid bodies while stationary or in motion. After this course students will be able to recognize similar problems in real-world situations and respond accordingly.

Prerequisite: Nil

Course Outcomes: After completion of the course the student will be able to:

CO 1	Recall principles and theorems related to rigid body mechanics
CO 2	Identify and describe the components of system of forces acting on the rigid body
CO 3	Apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	Choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	Solve problems involving rigid bodies, applying the properties of distributed areas and masses

Mapping of course outcomes with program outcomes (Minimum requirement)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO 4	3	3	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember	10	10	15
Understand	10	10	15
Apply	30	30	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Part A

Course Outcome 1 (CO1): (One question from each module to meet the course objective 1: *To recall principles and theorems related to rigid body mechanics***)**

1. Explain D'Alembert's principle

2. Distinguish static and dynamic friction

3. State and explain perpendicular axis theorem

Course Outcome 2 (CO2) (One question from each module to meet the course objective 2: *To identify and describe the components of system of forces acting on the rigid body***)**

1. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

2. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

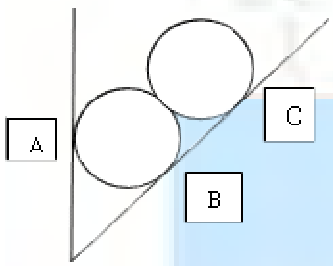
3. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

Part B

All the questions under this section shall assess the learning levels corresponding to the course outcomes listed below.

CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses

1. Two rollers each of weight 100 N are supported by an inclined plane and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth.

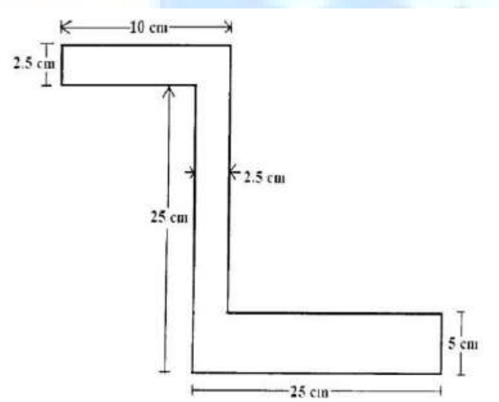


Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent equilibrium state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

2. A cylindrical disc, 50 cm diameter and cm thickness, is in contact with a horizontal conveyor belts running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s. Also compute the moment acting about the axis of the disc in both cases.

Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Sketch the free body diagram that represent state of the body)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
	Total		14

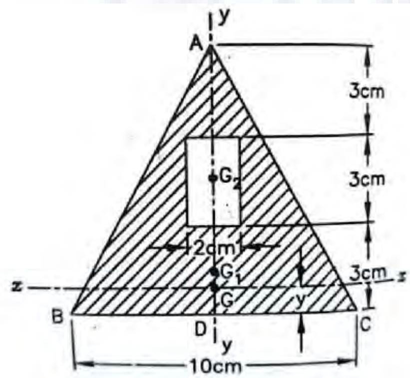
3. Determine the centroid of the given section



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of centroid for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed	Applying (Solve the problem based on the descriptions	6

	areas and masses	given in CO3 and CO4)	
Total			14

4. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC.



Course outcome identifier	Description of course outcome	Learning level assessed	Marks allocated
CO 3	To apply the conditions of equilibrium to various practical problems involving different force system.	Applying – (Illustrate the computation of moment of inertia for the given geometrical shape)	4
CO 4	To choose appropriate theorems, principles or formulae to solve problems of mechanics.	Applying (Choose the equations and formulae required for calculation)	4
CO 5	To solve problems involving rigid bodies, applying the properties of distributed areas and masses	Applying (Solve the problem based on the descriptions given in CO3 and CO4)	6
Total			14

Model Question Paper

QP CODE:

Reg No.:_______________

Name:___________________________ ___

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 100

ENGINEERING MECHANICS

Max. Marks: 100 Duration: 3 hours

Part A

(Answer all questions; each question carries 3 marks)

1. Explain D'Alembert's principle

2. Distinguish static and dynamic frictioni.

3. State and explain perpendicular axis theorem.

4. A simply supported beam AB of span 5 m is carrying point loads 5 kN, 3 kN and 2 kN at 1m, 3m and 4m respectively from support A. Calculate the support reaction at B.

5. A gymnast holding onto a bar, is suspended motionless in mid-air. The bar is supported by two ropes that attach to the ceiling. Diagram the forces acting on the combination of gymnast and bar

6. While you are riding your bike, you turn a corner following a circular arc. Illustrate the forces that act on your bike to keep you along the circular path ?

7. Compare damped and undamped free vibrations.

8. State the equation of motion of a rotating rigid body, rotating about its fixed axis.

9. Illustrate the significance of instantaneous centre in the analysis of rigid body undergoing rotational motion.

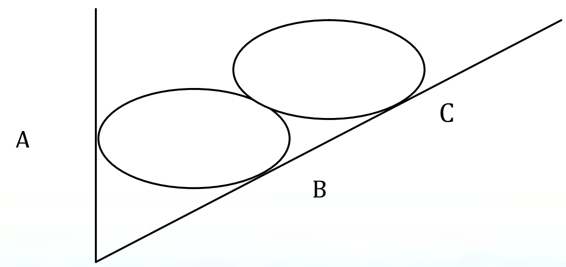
10. Highlight the principles of mechanics applied in the evaluation of elastic collusion of rigid bodies.

PART B

(Answer **one full** question from each module, each question carries **14** marks)

Module -I

11. Two identical rollers each of weight 100 N are supported by an inclined plane, making an angle of 30^{o} with the vertical, and a vertical wall. Find the reaction at the points of contact A, B, C. Assume all the surfaces to be smooth. (14 marks)

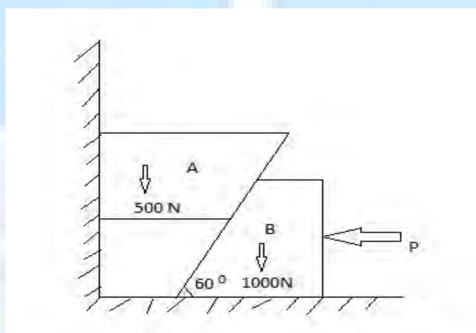


12. A string tied to a wall is made to pass over a pulley placed 2m away from it. A weight P is attached to the string such that the string stretches by 2m from the support on the wall to the location of attachment of weight. Determine the force P required to maintain 200 kg body in position for $\theta = 30^o$, The diameter of pulley B is negligible. (14 marks)

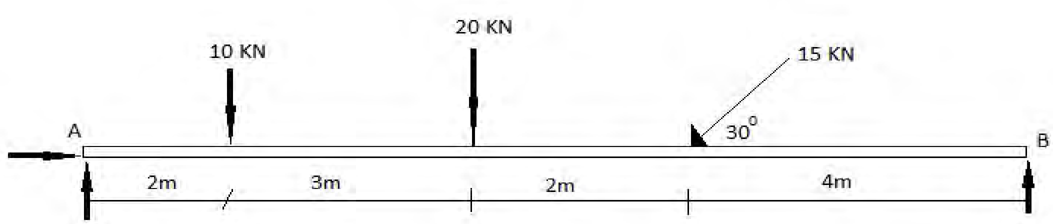
Module – 2

13. Two blocks A & B are resting against a wall and the floor as shown in figure below. Find the value of horizontal force P applied to the lower block that will hold the system in equilibrium. Coefficient of friction are : 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks.

(14 marks)

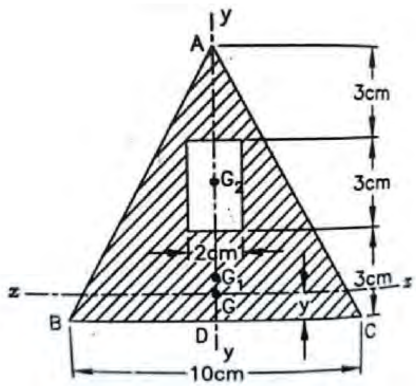


14. A beam is hinged at A and roller supported at B. It is acted upon by loads as shown below.
Find the reactions at A & B. (14 marks)



Module – 3

15. A rectangular hole is made in a triangular section as shown. Find moment of inertia about the section x-x passing through the CG of the section and parallel to BC. (14 marks)



16. Support A has ball and socket connection. Roller support at B prevents motion in the —z direction. Corner *C* is tied to *D* by a rope. The triangle is weightless. Determine the unknown force components acting at *A*, *B*, and *C*. (14 marks)

Module - 4

17. A cricket ball is thrown by a fielder from a height of 2m at an angle of 30^0 to the horizontal with an initial velocity of 20 m/s , hits the wickets at a height of 0.5 m from the ground. How far was the fielder from the wicket? (14 marks)

18. An engine of weight 500 kN pull a train weighing 1500 kN up an incline of 1 in 100. The train starts from rest and moves with constant acceleration against a resistance of 5 N/kN. It attains a maximum speed of 36 kmph in 1 km distance. Determine the tension in the coupling between train and engine and the traction force developed by the engine. (14marks)

Module – 5

19. A cylindrical disc, 50 cm diameter and 10 cm thickness having mass of 10 kg, is in contact with a horizontal conveyor belt running at uniform speeds of 5 m/s. Assuming there is no slip at points of contact determine (i) angular velocity of disc (ii) Angular acceleration of disc if velocity of conveyor changes to 8 m/s in 10 seconds. Also compute the moment acting about the axis of the disc in both cases. (14 marks)

20. A wheel rotating about fixed axis at 20 rpm is uniformly accelerated for 70 seconds during which time it makes 50 revolutions. Find the (i) angular velocity at the end of this interval and (ii) time required for the velocity to reach 100 revolutions per minute. (14 marks)

SYLLABUS

Module 1

Introduction to Engineering Mechanics-statics-basic principles of statics-Parallelogram law, equilibrium law, principles of superposition and transmissibility, law of action and reaction(review) free body diagrams.

Concurrent coplanar forces-composition and resolution of forces-resultant and equilibrium equations – methods of projections – methods of moments – Varignon's Theorem of moments.

Module 2

Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –wedges, ladder-analysis of connected bodies .

Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads. General coplanar force system - resultant and equilibrium equations.

Module 3

Centroid of composite areas- – moment of inertia-parallel axis and perpendicular axis theorems. Polar moment of inertia,radius of gyration,mass moment of inertia-ring,cylinder and disc.

Theorem of Pappus Guldinus(demonstration only)

Forces in space - vectorial representation of forces, moments and couples –resultant and equilibrium equations – concurrent forces in space (simple problems only)

Module 4

Dynamics – rectilinear translation - equations of kinematics(review)

kinetics – equation of motion – D'Alembert's principle. – motion on horizontal and inclined surfaces, motion of connected bodies. Impulse momentum equation and work energy equation (concepts only).

Curvilinear translation - equations of kinematics –projectile motion(review), kinetics – equation of motion. Moment of momentum and work energy equation (concepts only).

Module 5

Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – rotation under a constant moment.

Plane motion of rigid body – instantaneous centre of rotation (concept only).

Simple harmonic motion – free vibration –degree of freedom- undamped free vibration of spring mass system-effect of damping(concept only)

Text Books

1. Timoshenko and Young, Engineering Mechanics, McGraw Hill Publishers
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.

2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications

3. Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers

4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics, 9th Ed, Tata McGraw Hill

5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

Course Contents and Lecture Schedule:

Module	Topic	Course outcomes addressed	No. of Hours
1	**Module 1**		**Total: 7**
1.1	Introduction to engineering mechanics – introduction on statics and dynamics - Basic principles of statics – Parellogram law, equilibrium law – Superposition and transmissibility, law of action and reaction (review the topics)	CO1 and CO2	1
1.2	Free body diagrams. Degree of freedom-types of supports and nature of reactions - exercises for free body diagram preparation – composition and resolution of forces, resultant and equilibrium equations (review the topics) - numerical exercises for illustration.	CO1 and CO2	1
1.3	Concurrent coplanar forces - analysis of concurrent forces -methods of projections – illustrative numerical exercise – teacher assisted problem solving.	CO1 and CO2	1
1.4	Analysis of concurrent forces -methods of moment-Varignon's Theorem of Moments - illustrative numerical exercise– teacher assisted problem solving.	CO1 and CO2	1
1.5	Analysis of concurrent force systems – extended problem solving - Session I.	CO3,CO4 and CO5	1
1.6	Analysis of concurrent force systems – extended problem solving - Session II – learning review quiz.	CO3,CO4 and CO5	1
1.7	Analysis of concurrent force systems – extended problem solving - Session III.	CO3,CO4 and CO5	1
2	**Module 2**		**Total: 7**
2.1	Friction – sliding friction - Coulomb's laws of friction – analysis of single bodies –illustrative examples on wedges and ladder-teacher	CO1 and CO2	1

	assisted problem solving tutorials using problems from wedges and ladder.		
2.2	Problems on friction - analysis of connected bodies. illustrative numerical exercise– teacher assisted problem solving.	CO3, CO4 and CO5	1
2.3	Problems on friction-extended problem solving	CO3,C04 and CO5	1
2.4	Parallel coplanar forces – couple - resultant of parallel forces – centre of parallel forces – equilibrium of parallel forces – Simple beam subject to concentrated vertical loads.	CO1 and CO2	1
2.5	General coplanar force system - resultant and equilibrium equations - illustrative examples- teacher assisted problem solving.	CO1 and CO2	1
2.6	General coplanar force system-resultant and equilibrium equations - illustrative examples	CO3, CO4 and CO5	1
2.7	General coplanar force system - Extended problem solving - Quiz to evaluate learning level.	CO3, CO4 and CO5	1
3	**Module 3**		**Total: 7**
3.1	Centroid of simple and regular geometrical shapes – centroid of figures in combination - composite areas- examples for illustration – problems for practice to be done by self.	CO1 and CO2	1
3.2	Moment of inertia- parallel axis theorem –examples for illustration - problems for practice to be done by self.	CO1 and CO2	1
3.3	Moment of inertia - perpendicular axis theorem - example for illustration to be given as hand out and discussion on the solved example.	CO1 and CO2	1
3.4	Solutions to practice problems – problems related to centroid and moment of inertia - problems for practice to be done by self.	CO3, CO4 and CO5	1
3.5	Polar moment of inertia, Radius of gyration. Mass moment of inertia of ring, cylinder and uniform disc. Theorem of Pappus Guldinus - Demonstration	CO1 and CO2	1
3.6	Introduction to forces in space – vectorial representation of forces, moments and couples – simple problems to illustrate vector representations of forces, moments and couples to be done in class.	CO1,and CO2	1
3.7	Solution to practice problems - resultant and equilibrium equations for concurrent forces in space – concurrent forces in space - 2 simple problems to illustrate the application of resultant and equilibrium equations for concurrent forces in space.	CO3,CO4 and CO5	1
4	**Module 4**		**Total: 7**

4.1	Introduction to dynamics – review of rectilinear translation - equations of kinematics – problems to review the concepts – additional problems involving extended application as exercises .	CO1 and CO2	1
4.2	Solutions to exercises with necessary explanation given as hand out – introduction to kinetics – equation of motion – D'Alembert's principle – illustration of the concepts using one numerical exercise from motion on horizontal and inclined surfaces.	CO1 and CO2	1
4.3	Motion of connected bodies - example for illustration to be given as hand out and discussion on the solved example – problems for practice to be done by self.	CO3, CO4 and CO5	1
4.4	Motion of connected bodies-extended problem solving.	CO3, CO4 & CO5	1
4.5	Curvilinear translation - Review of kinematics –projectile motion – simple problems to review the concepts – introduction to kinetics – equation of motion – illustration of the concepts using numerical exercises.	CO3, CO4 & CO5	1
4.6	Extended problem solving – rectilinear and curvilinear translation.	CO3, CO4 & CO5	1
4.7	Concepts on Impulse momentum equation and work energy equation (rectilinear translation – discussions to bring out difference between elastic and inelastic collusions). Concepts on Moment of momentum and work energy equation (curvilinear translation).	CO1 and CO2	1
5	**Module 5**		**Total: 7**
5.1	Rotation – kinematics of rotation- equation of motion for a rigid body rotating about a fixed axis – simple problems for illustration.	CO1 and CO2	1
5.2	Rotation under a constant moment – teacher assisted problem solving.	CO3,CO4 and CO5	1
5.3	Rotation under a constant moment - extended problem solving.	CO3, CO4 and CO5	1
5.4	Plane motion of rigid body- instantaneous centre of rotation (concept only).	CO1 and CO2	1
5.5	Introduction to harmonic oscillation –free vibrations - simple harmonic motion – differential equation and solution. Degree of freedom – examples of single degree of freedom (SDOF) systems – Idealisation of mechanical systems as spring-mass systems (concept only).	CO1 and CO2	1

5.6	SDOF spring mass system –equation of motion – undamped free vibration response - concept of natural frequency. Free vibration response due to initial conditions. Simple problems on determination of natural frequency and free vibration response to test the understanding level.	CO1 and CO2	1
5.7	Free vibration analysis of SDOF spring-mass systems – Problem solving Effect of damping on free vibration response (concept only).	CO1and CO2	1

EST 110	ENGINEERING GRAPHICS	CATEGORY	L	T	P	CREDIT	Year of Introduction
		ESC	2	0	2	3	2019

Preamble: To enable the student to effectively perform technical communication through graphical representation as per global standards.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Draw the projection of points and lines located in different quadrants
CO 2	Prepare multiview orthographic projections of objects by visualizing them in different positions
CO 3	Draw sectional views and develop surfaces of a given object
CO 4	Prepare pictorial drawings using the principles of isometric and perspective projections to visualize objects in three dimensions.
CO 5	Convert 3D views to orthographic views
CO 6	Obtain multiview projections and solid models of objects using CAD tools

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3											
CO 2	3											
CO 3	3	1										
CO 4	3									1		
CO 5	3									2		
CO 6	3				3					3		

<u>Assessment Pattern</u>

Bloom's Category	Continuous Assessment Tests		End Semester Examination (100 Marks)
	Test 1 (15 Marks)	Test 2 (15 Marks)	
Remember			
Understand	5		20
Apply	10	10	80
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE (Marks)	ESE (Marks)	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

CIA for section A carries 25 marks (15 marks for 1 test and Class work 10 marks)

CIA for section B carries 15 marks (10 marks for 1 test and Class work 5 marks)

End Semester Examination Pattern:

ESE will be of 3 hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module of Section A only. Student has to answer any one question from each module. Each question carries 20 marks.

Course Level Assessment Questions

(Questions may be framed based on the outline given under each course outcome)

Course Outcome 1 (CO1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes .
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO2)

1. Draw orthographic views of solids and combination solids
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO3):

1. Draw views of solids sectioned by a cutting plane
2. Find location and inclination of cutting plane given true shape of the section
3. Draw development of lateral surface of solids and also its sectioned views

Course Outcome 4 (CO4):

1. Draw Isometric views/projections of soilds
2. Draw Isometric views/projections of combination of soilds
3. Draw Perspective views of Soilds

Course Outcome 5 (CO5):

1. Draw Orthographic views of solids from given three dimensional view

Course Outcome 6 (CO6):

1. Draw the given figure including dimensions using 2D software
2. Create 3D model using modelling software from the given orthographic views or 3D figure or from real 3D objects

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 110

ENGINEERING GRAPHICS

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

Instructions: Retain necessary Construction lines
Show necessary dimensions
Answer any ONE question from each module
Each question carries 20 marks

MODULE I

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes. Also locate the traces of the line.
2. One end of a line is 20mm from both the principal planes of projection. The other end of the line is 50mm above HP and 40mm in front of VP. The true length of the line is 70mm. Draw the projections of the line. Find its apparent inclinations, elevation length and plan length. Also locate its traces.

MODULE II

3. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^{o} to VP. Draw the projections of the solid.

4. A hexagonal prism has side 25mm and height 50mm has a corner of its base on the ground and the long edge containing that corner inclined at 30^o to HP and 45^o to VP. Draw the projections of the solid.

MODULE III

5. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.

6. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

MODULE IV

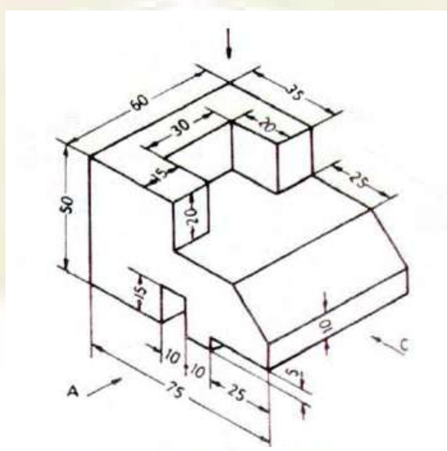
7. The frustum of a cone has base diameter 50mm and top diameter 40mm has a height of 60mm. It is paced centrally on top of a rectangular slab of size 80x60mm and of thickness 20mm. Draw the isometric view of the combination.

8. A hexagonal prism has base side 35mm and height 60mm. A sphere of diameter 40mm is placed centrally on top of it. Draw the isometric projection of the combination.

MODULE V

9. Draw the perspective view of a pentagonal prism, 20mm side and 45mm long lying on one of its rectangular faces on the ground and having its axis perpendicular to picture plane. One of its pentagonal faces touches the picture plane and the station point is 50mm in front of PP, 25mm above the ground plane and lies in a central plane, which is 70mm to the left of the center of the prism.

10. Draw three orthographic views with dimensions of the object shown in figure below.



(20X5=100)

Time : 3 hours **EST110 ENGINEERING GRAPHICS** **Max. Marks: 100**

SCHEME OF VALUATION

1. Locating the points and drawing the projections of the line – 4 marks
   Finding true length by any one method – 6 marks
   Finding true inclination with VP – 2 marks
   Finding true inclination with HP – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

2. Locating the points and drawing true length of the line – 4 marks
   Finding projections by any method – 6 marks
   Finding length of elevation and plan – 2 marks
   Finding apparent inclinations – 2 marks
   Locating horizontal trace – 2 marks
   Locating vertical trace – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

3. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used.
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

4. Drawing initial position plan and elevation – 4 marks
   First inclination views – 4 marks
   Second inclination views -8 marks
   Marking invisible edges – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Any one method or combination of methods for solving can be used
   If initial position is wrong then maximum 50% marks may be allotted for the answer)

5. Drawing initial position plan and elevation – 4 marks
   Locating section plane as per given condition – 5 marks
   Drawing true shape -5 marks
   Finding inclination of cutting plane – 2 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

6. Drawing initial position plan and elevation – 4 marks
   Development of the pyramid – 6 marks

Locating string in development -2 marks
Locating string in elevation – 3 marks
Locating string in plan – 3 marks
Dimensioning and neatness – 2 marks

Total = 20 marks

7. Drawing initial positions – 4 marks
   Isometric View of Slab -6 marks
   Isometric View of Frustum – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.
   Reduce 4 marks if Isometric scale is taken)

8. Drawing initial positions – 4 marks
   Isometric scale – 4 marks
   Isometric projection of prism -5 marks
   Isometric projection of sphere – 5 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

   (Initial position is optional, hence redistribute if needed.

9. Drawing the planes and locating the station point – 4 marks
   Locating elevation points – 2 marks
   Locating plan points – 2 marks
   Drawing the perspective view – 10 marks
   Dimensioning and neatness – 2 marks

   Total = 20 marks

10. Drawing the elevation – 8marks
    Drawing the plan – 4 marks
    Drawing the side view – 4 marks
    Marking invisible edges – 2 marks
    Dimensioning and neatness – 2 marks

    Total = 20 marks

SYLLABUS

General Instructions:

- First angle projection to be followed
- Section A practice problems to be performed on A4 size sheets
- Section B classes to be conducted on CAD lab

SECTION A

Module 1

Introduction : Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines: Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

Module 2

Orthographic projection of Solids: Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position including profile view. Projection of solids with axis inclined to one of the reference planes and with axis inclined to both reference planes.

Module 3

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes. True shape of the sections. Also locating the section plane when the true shape of the section is given.

Development of Surfaces: Development of surfaces of the above solids and solids cut by different section planes. Also finding the shortest distance between two points on the surface.

Module 4

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone , Cylinder, Frustum of Pyramid, Frustum of Cone, Sphere, Hemisphere and their combinations.

Module 5

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

SECTION B

(To be conducted in CAD Lab)

Introduction to Computer Aided Drawing: Role of CAD in design and development of new products, Advantages of CAD. Creating two dimensional drawing with dimensions using suitable software. (Minimum 2 exercises mandatory)

Introduction to Solid Modelling: Creating 3D models of various components using suitable modelling software. (Minimum 2 exercises mandatory)

Text Books

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.

Reference Books

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
3. Benjamin, J., Engineering Graphics, Pentex Publishers- 3rd Edition, 2017
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

Course Contents and Lecture Schedule

No	**SECTION A**	No. of Hours
1	**MODULE I**	
1.1	Introduction to graphics, types of lines, Dimensioning	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane. Lines inclined to both planes, trapezoid method of solving problems on lines.	2
1.4	Problems on lines using trapezoid method	2
1.5	Line rotation method of solving, problems on line rotation method	2
2	**MODULE II**	
2.1	Introduction of different solids, Simple position plan and elevation of solids	2
2.2	Problems on views of solids inclined to one plane	2
2.3	Problems on views of solids inclined to both planes	2
2.4	Practice problems on solids inclined to both planes	2

3	**MODULE III**	
3.1	Introduction to section planes. AIP and AVP. Principle of locating cutting points and finding true shape	2
3.2	Problems on sections of different solids	2
3.3	Problems when the true shape is given	2
3.4	Principle of development of solids, sectioned solids	2
4	**MODULE IV**	
4.1	Principle of Isometric View and Projection, Isometric Scale. Problems on simple solids	2
4.2	Isometric problems on Frustum of solids, Sphere and Hemisphere	2
4.3	Problems on combination of different solids	2
5	**MODULE V**	
5.1	Introduction to perspective projection, different planes, station point etc. Perspective problems on pyramids	2
5.2	Perspective problems on prisms	2
5.3	Practice on conversion of pictorial views into orthographic views	2
	SECTION B *(To be conducted in CAD lab)*	
1	Introduction to CAD and software. Familiarising features of 2D software. Practice on making 2D drawings	2
2	Practice session on 2D drafting	2
3	Introduction to solid modelling and software	2
4	Practice session on 3D modelling	2

EST 120	BASICS OF CIVIL & MECHANICAL ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:

Objective of this course is to provide an insight and inculcate the essentials of Civil Engineering discipline to the students of all branches of Engineering and to provide the students an illustration of the significance of the Civil Engineering Profession in satisfying the societal needs.

To introduce the students to the basic principles of mechanical engineering

Prerequisite: NIL

Course Outcomes: After completion of the course, the student will be able to

CO 1	Recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.
CO 2	Explain different types of buildings, building components, building materials and building construction
CO 3	Describe the importance, objectives and principles of surveying.
CO 4	Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps
CO 5	Discuss the Materials, energy systems, water management and environment for green buildings.
CO 6	Analyse thermodynamic cycles and calculate its efficiency
CO 7	Illustrate the working and features of IC Engines
CO 8	Explain the basic principles of Refrigeration and Air Conditioning
CO 9	Describe the working of hydraulic machines
CO 10	Explain the working of power transmission elements
CO 11	Describe the basic manufacturing, metal joining and machining processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	2	2	-	-	-	-
CO2	3	2	-	1	3	-	-	3	-	-	-	-
CO3	3	2	-	-	3	-	-	-	2	-	-	-

CO4	3	2	-	-	3	-	-	-	2	-	-	-
CO5	3	2	-	-	3	2	3	-	2	-	-	-
CO6	3	2										
CO7	3	1										
CO8	3	1										
CO9	3	2										
CO10	3	1										
CO11	3											

Assessment Pattern

	Basic Civil Engineering			**Basic Mechanical Engineering**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (marks)**	**Continuous Assessment**		**End Semester Examination (marks)**
	Test 1 marks	**Test 2 marks**		**Test 1 marks**	**Test 2 marks**	
Remember	5	5	10	7.5	7.5	15
Understand	20	20	40	12.5	12.5	25
Apply				5	5	10
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	**CIE (Marks)**	**ESE (Marks)**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part I – Basic Civil Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts -

Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions:

Course Outcome CO1: *To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering.*

1.Explain relevance of Civil engineering in the overall infrastructural development of the country.
Course outcome 2 (CO2) (One question from each module and not more than two)

Explain different types of buildings, building components, building materials and building construction

1. Discuss the difference between plinth area and carpet area.

Course outcome 3 (CO3) (One question from each module and not more than two)

Describe the importance, objectives and principles of surveying.

1. Explain the importance of surveying in Civil Engineering

Course outcome 4 (CO4) (One question from each module and not more than two)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps

1. Explain the civil engineering aspects of elevators, escalators and ramps in buildings

Course outcome 5 (CO5) (One question from each module and not more than two)

Discuss the Materials, energy systems, water management and environment for green buildings.

1. Discuss the relevance of Green building in society

Section II *Answer any 1 full question from each module. Each full question carries 10 marks*

Course Outcome 1 (CO1) (Two full question from each module and each question can have maximum 2 sub-divisions)

To recall the role of civil engineer in society and to relate the various disciplines of Civil Engineering
CO Questions

1. a List out the types of building as per occupancy. Explain any two, each in about five sentences.
b. Discuss the components of a building with a neat figure.
2. a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework.

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country.

Course Outcome 2 (CO2) & Course Outcome 3 (CO3) (Two full question from each module and each question can have maximum 2 sub-divisions)

Explain different types of buildings, building components, building materials and building construction & Describe the importance, objectives and principles of surveying.

CO Questions

1. **a.** What are the different kinds of cement available and what is their use.
   b. List the properties of good building bricks. Explain any five.
2. a. List and explain any five modern construction materials used for construction.
   b. Explain the objectives and principles of surveying

Course outcome 4 (CO4) & Course outcome 5 (CO5) (Two full question from each module and each question can have maximum 2 sub-divisions)

Summarise the basic infrastructure services MEP, HVAC, elevators, escalators and ramps & Discuss the Materials, energy systems, water management and environment for green buildings.

CO Questions

1. **a**. Draw the elevation and plan of one brick thick wall with English bond
   b. Explain the energy systems and water management in Green buildings

2. **a.** Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing.

   b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building

Course Outcome 6 (CO6):

1. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find
   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii) Cycle efficiency
   Take Cp = 1.005 kJ/kgK and Cv=0.718 kJ/kgK
2. A Carnot cycle works with adiabatic compression ratio of 5 and isothermal expansion ratio of 2. The volume of air at the beginning of isothermal expansion is 0.3 m^3. If the maximum temperature and pressure is limited to 550K and 21 bar, determine the minimum temperature in the cycle and efficiency of the cycle.
3. In an ideal diesel cycle, the temperature at the beginning and end of compression is 65°C and 620°C respectively. The temperature at the beginning and end of the expansion is 1850°C and 850 °C. Determine the ideal efficiency of the cycle.

4. Explain the concepts of CRDI and MPFI in IC Engines.

Course Outcome 7 (CO7)

1. With the help of a neat sketch explain the working of a 4 stroke SI engine
2. Compare the working of 2 stroke and 4 stroke IC engines
3. Explain the classification of IC Engines.

Course Outcome 8(CO8):

1. Explain the working of vapour compression refrigeration system.
2. With the help of suitable sketch explain the working of a split air conditioner.
3. Define: COP, specific humidity, relative humidity and dew point temperature.

Course Outcome 9 (CO9):

1. Explain the working of a single stage centrifugal pump with sketches.
2. With the help of a neat sketch, explain the working of a reciprocating pump.
3. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the overall efficiency of the turbine is 90%. Determine the power developed by the turbine.

Course Outcome 10 (CO10):

1. Explain the working of belt drive and gear drive with the help of neat sketches
2. Explain a single plate clutch.
3. Sketch different types of gear trains and explain.

Course Outcome 11 (CO11):

1. Describe the operations which can be performed using drilling machine.
2. Explain the functions of runners and risers used in casting.
3. With a neat sketch, explain the working and parts of a lathe.

Model Question Paper

QP CODE: **EST120** page:3

Reg No:___________________

Name:______________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 120

Course Name: BASICS OF CIVIL AND MECHANICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

PART I: BASIC CIVIL ENGINEERING

PART A

(Answer all questions. Each question carries 4 marks)

1. Explain relevance of Civil engineering in the overall infrastructural development of the country.
2. Discuss the difference between plinth area and carpet area.
3. Explain different types of steel with their properties.
4. What are the different kinds of cement available and what is their use?
5. Define bearing capacity of soil.

(5 x 4 = 20)

Part B

Answer one full question from each module.

MODULE I

6a. List out the types of building as per occupancy. Explain any two, each in about five sentences. (5)

b. Discuss the components of a building with a neat figure. (5)

OR

7a. What are the major disciplines of civil engineering and explain their role in the infrastructural framework. (5)

b. Explain the role of NBC, KBR & CRZ norms in building rules and regulations prevailing in our country. (5)

MODULE II

8a. What are the different kinds of cement available and what is their use. (5)

b. List the properties of good building bricks. Explain any five. (5)

OR

9a. List and explain any five modern construction materials used for construction. (5)

b. Explain the objectives and principles of surveying (5)

MODULE III

10a. Draw the elevation and plan of one brick thick wall with English bond (5)

b. Explain the energy systems and water management in Green buildings (5)

OR

11a. Draw neat sketch of the following foundations: (i) Isolated stepped footing; (ii) Cantilever footing; and (iii) Continuous footing. (5)

b. Discuss the civil engineering aspect of MEP and HVAC in a commercial building (5)

[10 x 3 = 30]

PART II: BASIC MECHANICAL ENGINEERING

PART A

Answer all questions. Each question carries 4 marks

1. Sketch the P-v and T-s diagram of a Carnot cycle and List the processes.
2. Illustrate the working of an epicyclic gear train.
3. Explain cooling and dehumidification processes.
4. Differentiate between soldering and brazing.
5. Explain the principle of Additive manufacturing.

4 x 5 = 20 marks

Part B

Answer one full question from each module.

MODULE I

6. In an air standard Otto cycle the compression ratio is 7 and compression begins at 35°C, 0.1MPa. The maximum temperature of the cycle is 1100°C. Find

   i) Heat supplied per kg of air,
   ii) Work done per kg of air,
   iii)Cycle efficiency

   Take C_p = 1.005 kJ/kgK and C_v=0.718 kJ/kgK — 10 marks

OR

7. a) Explain the working of a 4 stroke SI engine with neat sketches. — 7 marks
   b) Explain the fuel system of a petrol engine. — 3 marks

MODULE II

8. a) Explain the working of a vapour compression system with help of a block diagram. — 7 marks
   b) Define: Specific humidity, relative humidity and dew point temperature. — 3 marks

OR

9. With the help of a neat sketch, explain the working of a centrifugal pump. — 10 marks

MODULE III

10. Explain the two high, three high, four high and cluster rolling mills with neat sketches. — 10 marks

OR

11. a) Describe the arc welding process with a neat sketch. — 6 marks
    b) Differentiate between up-milling and down-milling operations. — 4 marks

SYLLABUS

Module 1

General Introduction to Civil Engineering: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment. Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.

Introduction to buildings: Types of buildings, selection of site for buildings, components of a residential building and their functions.

Building rules and regulations: Relevance of NBC, KBR & CRZ norms (brief discussion only).

Building area: Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.

Module 2

Surveying: Importance, objectives and principles.

Construction materials, Conventional construction materials**:** types, properties and uses of building materials: bricks, stones, cement, sand and timber

Cement concrete: Constituent materials, properties and types.

Steel: Steel sections and steel reinforcements, types and uses.

Modern construction materials:- Architectural glass, ceramics, Plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials. Modern uses of gypsum, pre-fabricated building components (brief discussion only).

Module 3

Building Construction: Foundations: Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Load bearing and framed structures (concept only).

Brick masonry: - Header and stretcher bond, English bond & Flemish bond random rubble masonry.

Roofs and floors: - Functions, types; flooring materials (brief discussion only).

Basic infrastructure services: MEP, HVAC, elevators, escalators and ramps (Civil Engineering aspects only), fire safety for buildings.

Green buildings:- Materials, energy systems, water management and environment for green buildings. (brief discussion only).

Module 4

Analysis of thermodynamic cycles: Carnot, Otto, Diesel cycles, Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency. IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines. Efficiencies of IC Engines(Definitions only), Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines.

Module 5

Refrigeration: Unit of refrigeration, reversed Carnot cycle,COP, vapour compression cycle (only description and no problems); Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.

Description about working with sketches of: Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)

Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches.

Module 6

Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.

Metal Joining Processes: List types of welding, Description with sketches of Arc Welding, Soldering and Brazing and their applications

Basic Machining operations: Turning, Drilling, Milling and Grinding.

Description about working with block diagram of: Lathe, Drilling machine, Milling machine, CNC Machine. Principle of CAD/CAM, Rapid and Additive manufacturing.

Text Books:

1. Rangwala, S. C., Essentials of Civil Engineering, Charotar Publishing House
2. Mckay, W.B. and Mckay, J. K., Building Construction, Volumes 1 to 4, Pearson India Education Services

References Books:

1. Chen W.F and Liew J Y R (Eds), The Civil Engineering Handbook. II Edition CRC Press (Taylor and Francis)
2. Chudley, R and Greeno R, Building construction handbook, Addison Wesley, Longman group, England
3. Chudley, R, Construction Technology, Vol. I to IV, Longman group, England Course Plan
4. Kandya A A, Elements of Civil Engineering, Charotar Publishing house
5. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers
6. Rangwala S.C and Dalal K B Building Construction Charotar Publishing house
7. Clifford, M., Simmons, K. and Shipway, P., An Introduction to Mechanical Engineering Part I - CRC Press
8. Roy and Choudhary, Elements of Mechanical Engineering, Media Promoters &Publishers Pvt. Ltd., Mumbai.
9. Sawhney, G. S., Fundamentals of Mechanical Engineering, PHI
10. G Shanmugam, M S Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education; First edition, 2018
11. Benjamin,J.,Basic Mechanical Engineering,Pentex Books,9th Edition,2018
12. Balachandran, P.Basic Mechanical Engineering,Owl Books

Course Contents and Lecture Schedule:

No	Topic	Course outcomes addressed	No. of Lectures
1	**Module I**		**Total: 7**
1.1	*General Introduction to Civil Engineering*: Relevance of Civil Engineering in the overall infrastructural development of the country. Responsibility of an engineer in ensuring the safety of built environment.	CO1	1
1.2	Brief introduction to major disciplines of Civil Engineering like Transportation Engineering, Structural Engineering, Geo-technical Engineering, Water Resources Engineering and Environmental Engineering.	CO1	2
1.3	*Introduction to buildings:* Types of buildings, selection of site for buildings, components of a residential building and their functions.	CO2	2
1.4	*Building rules and regulations:* Relevance of NBC, KBR & CRZ norms (brief discussion only)	CO2	1
1.5	*Building area:* Plinth area, built up area, floor area, carpet area and floor area ratio for a building as per KBR.	CO2	1
2	**Module 2**		**Total: 7**
2.1	*Surveying:* Importance, objectives and principles.	CO3	1
2.2	Bricks: - Classification, properties of good bricks, and tests on bricks	CO2	1
2.3	Stones: - *Qualities* of good stones, types of stones and their uses. Cement: - Good qualities of cement, types of cement and their uses.	CO2	1
2.4	Sand: - Classification, qualities of good sand and sieve analysis (basics only). Timber: - Characteristics, properties and uses.	CO2	1
2.5	Cement concrete: - Constituent materials, properties and types, Steel: - Steel sections and steel reinforcements, types and uses.	CO2	1

2.6	Modern construction materials: - Architectural glass, ceramics, plastics, composite materials, thermal and acoustic insulating materials, decorative panels, waterproofing materials, modern uses of gypsum, pre-fabricated building components (brief discussion only)	CO2	2
3	**Module 3**		**Total: 7**
3.1	Foundations: - Bearing capacity of soil (definition only), functions of foundations, types – shallow and deep (brief discussion only). Brick masonry: - Header and stretcher bond, English bond & Flemish bond– elevation and plan (one & one and a half brick wall only). Random rubble masonry.	CO2	2
3.2	Roofs: Functions, types; roofing materials (brief discussion only) Floors: Functions, types; flooring materials (brief discussion only)	CO2	2
3.3	*Basic infrastructure services:* MEP, HVAC, Elevators, escalators and ramps (Civil Engineering aspects only) fire safety for buildings	CO4	2
3.4	*Green buildings:*- Materials, energy systems, water management and environment for green buildings. (brief discussion only)	CO5	1
4	**MODULE 4**		
4.1	Analysis of thermodynamic cycles: Carnot, Otto, and Diesel cycle-Derivation of efficiency of these cycles, Problems to calculate heat added, heat rejected, net work and efficiency	4	
4.2	IC Engines: CI, SI, 2-Stroke, 4-Stroke engines. Listing the parts of different types of IC Engines, efficiencies of IC Engines(Description only)	2	
4.3	Air, Fuel, cooling and lubricating systems in SI and CI Engines, CRDI, MPFI. Concept of hybrid engines	2	
5	**MODULE 5**		
5.1	Refrigeration: Unit of refrigeration, reversed Carnot cycle, COP, vapour compression cycle (only description and no problems)	1	
5.2	Definitions of dry, wet & dew point temperatures, specific humidity and relative humidity, Cooling and dehumidification, Layout of unit and central air conditioners.	1	

5.3	Description about working with sketches : Reciprocating pump, Centrifugal pump, Pelton turbine, Francis turbine and Kaplan turbine. Overall efficiency, Problems on calculation of input and output power of pumps and turbines (No velocity triangles)	4
5.4	Description about working with sketches of: Belt and Chain drives, Gear and Gear trains, Single plate clutches	3
6	**MODULE 6**	
6.1	Manufacturing Process: Basic description of the manufacturing processes – Sand Casting, Forging, Rolling, Extrusion and their applications.	2
6.2	Metal Joining Processes :List types of welding, Description with sketches of Arc Welding, Soldering and Brazing, and their applications	1
6.3	Basic Machining operations: Turning, Drilling, Milling and Grinding Description about working with block diagrams of: Lathe, Drilling machine, Milling machine, CNC Machine	3
6.4	Principle of CAD/CAM, Rapid and Additive manufacturing	1

EST 130	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	4	0	0	4	2019

Preamble:
This course aims to (1) equip the students with an understanding of the fundamental principles of electrical engineering(2) provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits (3) provide an overview of evolution of communication systems, and introduce the basic concepts in radio communication.

Prerequisite: Physics and Mathematics (Pre-university level)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO 2	Develop and solve models of magnetic circuits
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits in steady state
CO 4	Describe working of a voltage amplifier
CO 5	Outline the principle of an electronic instrumentation system
CO 6	Explain the principle of radio and cellular communication

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	3	1	-	-	-	-	-	-	-	-	-	2
CO 3	3	1	-	-	-	-	-	-	-	-	-	2
CO 4	2	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	-	-	-	-	-	-	-	-	-	-	2
CO 6	2	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	**Basic Electrical Engineering**			**Basic Electronics Engineering**		
	Continuous Assessment Tests		**End Semester Examination (Marks)**	**Continuous Assessment Tests**		**End Semester Examination (Marks)**
	Test 1 (Marks)	**Test 2 (Marks)**		**Test 1 (Marks)**	**Test 2 (Marks)**	
Remember	0	0	10	10	10	20
Understand	12.5	12.5	20	15	15	30
Apply	12.5	12.5	20			
Analyse						
Evaluate						
Create						

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module out of which one to be answered. Each question carries 10 mark and can have maximum 2 sub-divisions. The pattern for end semester examination for part II is same as that of part I. **However, student should answer both part I and part 2 in separate answer booklets.**

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Solve problems based on current division rule.

2. Solve problems with Mesh/node analysis.

3. Solve problems on Wye-Delta Transformation.

Course Outcome 2 (CO2):

1. Problems on series magnetic circuits

2. Problems on parallel magnetic circuits

3. Problems on composite magnetic ciruits

4. **Course Outcome 3 (CO3):**

1. problems on self inductance, mutual inductance and coefficient of coupling

2. problems on rms and average values of periodic waveforms

3. problems on series ac circuits

4. Compare star and Delta connected 3 phase AC systems.

Course Outcome 4 (CO4): Describe working of a voltage amplifier

1.What is the need of voltage divider biasing in an RC coupled amplifier?

2. Define operating point in the context of a BJT amplifier.

3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 5 (CO5): Outline the principle of an electronic instrumentation system

1. Draw the block diagram of an electronic instrumentation system.

2. What is a transducer?

3. Explain the working principle of operation of digital multimeter.

Course Outcome 6 (CO6): Explain the principle of radio and cellular communication

1. What is the working principle of an antenna when used in a radio transmitter?

2. What is the need of two separate sections RF section and IF section in a super heterodyne receiver?

3. What is meant by a cell in a cellular communication?

Model Question Paper

QP CODE: Pages: 3

Reg No.:________________

Name:__________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: EST 130

Course Name: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

Max. Marks: 100 Duration: 3 hours

Answer both part I and part 2 in separate answer booklets

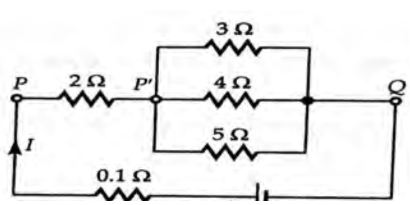
PART I

BASIC ELECTRICAL ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Calculate the current through the 4Ω resistor in the circuit shown, applying current division rule:



2. Calculate the RMS and average values of a purely sinusoidal current having peak value 15A.

3. An alternating voltage of (80+j60)V is applied to an RX circuit and the current flowing through the circuit is (-4+j10)A. Calculate the impedance of the circuit in rectangular and polar forms. Also determine if X is inductive or capacitive.

4. Derive the relation between line and phase values of voltage in a three phase star connected system.

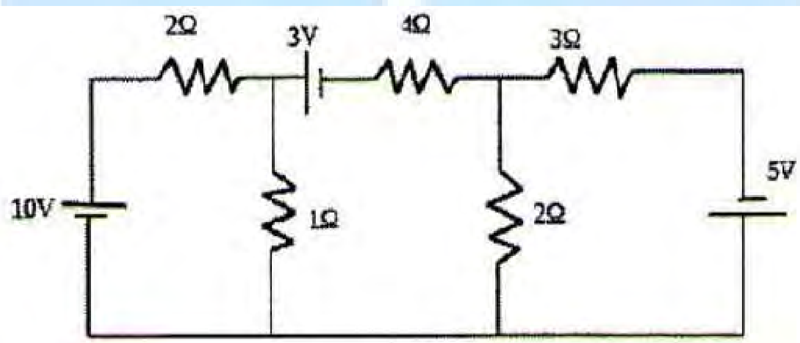
5. Compare electric and magnetic circuits. *(5x4=20)*

PART B

Answer one question from each module; each question carries 10 marks.

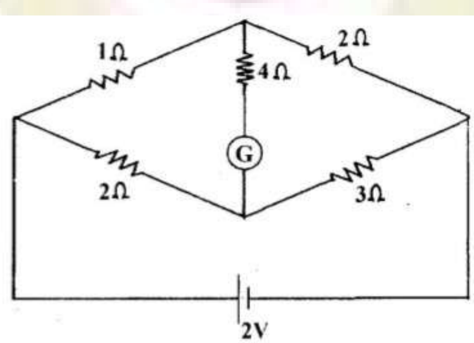
Module 1

6. . Calculate the node voltages in the circuit shown, applying node analysis:



7. (a) State and explain Kirchhoff's laws. (4 marks)

(b) Calculate the current through the galvanometer (G) in the circuit shown:



(6 marks)

Module 2

8. (a) State and explain Faraday's laws of electromagnetic induction with examples. (4 marks)

(b) Differentiate between statically and dynamically induced emf. A conductor of length 0.5m moves in a uniform magnetic field of flux density 1.1T at a velocity of 30m/s. Calculate the emf induced in the conductor if the direction of motion of the conductor is inclined at 60^0 to the direction of field. (6 marks)

9. (a) Derive the amplitude factor and form factor of a purely sinusoidal waveform. (5 marks)

(b) A current wave is made up of two components-a 5A dc component and a 50Hz ac component, which is a sinusoidal wave with a peak value of 5A. Sketch the resultant waveform and determine its RMS and average values. (5 marks)

Module 3

10. Draw the power triangle and define active, reactive and apparent powers in ac circuits. Two coils A and B are connected in series across a 240V, 50Hz supply. The resistance of A is $5\,\Omega$ and the inductance of B is 0.015H. If the input from the supply is 3kW and 2kVAR, find the inductance of A and the resistance of B. Also calculate the voltage across each coil.

11. A balanced three phase load consists of three coils each having resistance of 4Ω and inductance 0.02H. It is connected to a 415V, 50Hz, 3-phase ac supply. Determine the phase voltage, phase current, power factor and active power when the loads are connected in (i) star (ii) delta.

(3x10=30)

PART II

BASIC ELECTRONICS ENGINEERING

PART A

Answer all questions; each question carries 4 marks.

1. Give the specifications of a resistor. The colour bands marked on a resistor are Blue, Grey, Yellow and Gold. What are the minimum and maximum resistance values expected from that resistance?
2. What is meant by avalanche breakdown?
3. Explain the working of a full-wave bridge rectifier.
4. Discuss the role of coupling and bypass capacitors in a single stage RC coupled amplifier.
5. Differentiate AM and FM communication systems.

(5x4=20)

PART B

Answer one question from each module; each question carries 10 marks.

Module 4

6. a) Explain with diagram the principle of operation of an NPN transistor. (5)
   b) Sketch and explain the typical input-output characteristics of a BJT when connected in common emitter configuration. (5)

OR

7. a) Explain the formation of a potential barrier in a P-N junction diode. (5)
   b) What do you understand by Avalanche breakdown? Draw and explain the V-I characteristics of a P-N junction and Zener diode. (5)

Module 5

8. a) With a neat circuit diagram, explain the working of an RC coupled amplifier. (6)
   b) Draw the frequency response characteristics of an RC coupled amplifier and state the reasons for the reduction of gain at lower and higher frequencies. (4)

OR

9. a) With the help of block diagram, explain how an electronic instrumentation system. (6)
   b) Explain the principle of an antenna. (4)

Module 6

10. a) With the help of a block diagram, explain the working of Super hetrodyne receiver. (6)
    b) Explain the importance of antenna in a communication system. (4)

OR

11. a) With neat sketches explain a cellular communication system. (5)
    b) Explain GSM communication with the help of a block diagram. (5)

(3x10=30)

SYLLABUS

MODULE 1: Elementary Concepts of Electric Circuits

Elementary concepts of DC electric circuits: Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.

Analysis of DC electric circuits: Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.

MODULE 2: Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals

Magnetic Circuits: Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.

Electromagnetic Induction: Faraday's laws, problems, Lenz's law- statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling

Alternating Current fundamentals: Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.

MODULE 3: AC Circuits

AC Circuits: Phasor representation of sinusoidal quantities. Trignometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.

Three phase AC systems: Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems

MODULE 4

Introduction to Semiconductor devices: Evolution of electronics – Vacuum tubes to nano electronics. Resistors, Capacitors and Inductors (constructional features not required): types, specifications. Standard values, color coding. PN Junction diode: Principle of operation, V-I characteristics, principle of avalanche breakdown. Bipolar Junction Transistors: PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration.

MODULE 5

Basic electronic circuits and instrumentation: Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

MODULE 6

Introduction to Communication Systems: Evolution of communication systems – Telegraphy to 5G. Radio communication: principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge. Mobile communication: basic principles of cellular communications, principle and block diagram of GSM.

Text Books

1. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D C Kulshreshtha, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
3. ChinmoySaha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.
4. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.
5. Wayne Tomasi and Neil Storey, A Textbook On Basic Communication and Information Engineering, Pearson, 2010.

Reference Books

1. Del Toro V, “Electrical Engineering Fundamentals”, Pearson Education.
2. T. K. Nagsarkar, M. S. Sukhija, “Basic Electrical Engineering”, Oxford Higher Education.
3. Hayt W H, Kemmerly J E, and Durbin S M, “Engineering Circuit Analysis”, Tata McGraw-Hill
4. Hughes, “Electrical and Electronic Technology”, Pearson Education.
5. V. N. Mittle and Arvind Mittal, “Basic Electrical Engineering,” Second Edition, McGraw Hill.
6. Parker and Smith, “Problems in Electrical Engineering”, CBS Publishers and Distributors.
7. S. B. Lal Seksena and Kaustuv Dasgupta, “Fundamentals of Electrical Engineering”, Cambridge University Press.
8. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
9. Bernard Grob, Ba sic Electronics, McGraw Hill.
10. A. Bruce Carlson, Paul B. Crilly, Communication Systems: An Introduction to Signals and Noise in Electrical Communication, Tata McGraw Hill, 5th Edition.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lectures
1	***Elementary Concepts of Electric Circuits***	
1.1	**Elementary concepts of DC electric circuits:** Basic Terminology including voltage, current, power, resistance, emf; Resistances in series and parallel; Current and Voltage Division Rules; Capacitors & Inductors: V-I relations and energy stored. Ohms Law and Kirchhoff's laws-Problems; Star-delta conversion (resistive networks only-derivation not required)-problems.	1 2 1
1.2	**Analysis of DC electric circuits:** Mesh current method - Matrix representation - Solution of network equations. Node voltage methods-matrix representation-solution of network equations by matrix methods. Numerical problems.	1 1 2
2	**Elementary Concepts of Magnetic circuits, Electromagnetic Induction and AC fundamentals**	
2.1	**Magnetic Circuits:** Basic Terminology: MMF, field strength, flux density, reluctance - comparison between electric and magnetic circuits- Series and parallel magnetic circuits with composite materials, numerical problems.	1 2
2.2	**Electromagnetic Induction:** Faraday's laws, problems, Lenz's law-statically induced and dynamically induced emfs - Self-inductance and mutual inductance, coefficient of coupling	1 2
2.3	**Alternating Current fundamentals:** Generation of alternating voltages-Representation of sinusoidal waveforms: frequency, period, Average, RMS values and form factor of waveforms-Numerical Problems.	2
3	**AC Circuits**	

3.1	**AC Circuits:** Phasor representation of sinusoidal quantities. Trigonometric, Rectangular, Polar and complex forms. Analysis of simple AC circuits: Purely resistive, inductive & capacitive circuits; Inductive and capacitive reactance, concept of impedance. Average Power, Power factor. Analysis of RL, RC and RLC series circuits-active, reactive and apparent power. Simple numerical problems.	1 2 1 2
3.2	**Three phase AC systems:** Generation of three phase voltages; advantages of three phase systems, star and delta connections (balanced only), relation between line and phase voltages, line and phase currents- Numerical problems.	2
4	**Introduction to Semiconductor devices**	
4.1	Evolution of electronics – Vacuum tubes to nano electronics (In evolutional perspective only)	1
4.2	Resistors, Capacitors and Inductors: types, specifications. Standard values, color coding (No constructional features)	2
4.3	**PN Junction diode**: Principle of operation, V-I characteristics, principle of avalanche breakdown	2
4.4	**Bipolar Junction Transistors:** PNP and NPN structures, Principle of operation, relation between current gains in CE, CB and CC, input and output characteristics of common emitter configuration	3
5	**Basic electronic circuits and instrumentation**	
5.1	**Rectifiers and power supplies:** Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator	3
5.2	**Amplifiers:** Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response, Concept of voltage divider biasing	4
5.3	**Electronic Instrumentation:** Block diagram of an electronic instrumentation system	2
6	**Introduction to Communication Systems**	
6.1	Evolution of communication systems – Telegraphy to 5G	1

6.2	**Radio communication:** principle of AM & FM, frequency bands used for various communication systems, block diagram of super heterodyne receiver, Principle of antenna – radiation from accelerated charge	4
6.3	**Mobile communication:** basic principles of cellular communications, principle and block diagram of GSM.	2

Suggested Simulation Assignments for Basic Electronics Engineering

1. Plot V-I characteristics of Si and Ge diodes on a simulator
2. Plot Input and Output characteristics of BJT on a simulator
3. Implementation of half wave and full wave rectifiers
4. Simulation of RC coupled amplifier with the design supplied
5. Generation of AM signal

Note: The simulations can be done on open tools such as QUCS, KiCad, GNURadio or similar software to augment the understanding.

HUN 102	PROFESSIONAL COMMUNICATION	CATEGORY	L	T	P	CREDIT
		MNC	2	0	2	--

Preamble: Clear, precise, and effective communication has become a *sine qua non* in today's information-driven world given its interdependencies and seamless connectivity. Any aspiring professional cannot but master the key elements of such communication. The objective of this course is to equip students with the necessary skills to listen, read, write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop vocabulary and language skills relevant to engineering as a profession
CO 2	Analyze, interpret and effectively summarize a variety of textual content
CO 3	Create effective technical presentations
CO 4	Discuss a given technical/non-technical topic in a group setting and arrive at generalizations/consensus
CO 5	Identify drawbacks in listening patterns and apply listening techniques for specific needs
CO 6	Create professional and technical documents that are clear and adhering to all the necessary conventions

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1										3		2
CO 2										1		3
CO 3						1			1	3		
CO 4										3		1
CO 5		1							2	3		
CO 6	1					1			1	3		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation

Total Marks: 50

Attendance	: 10 marks
Regular assessment	: 25 marks
Series test (one test only, should include verbal aptitude for placement and higher studies, this test will be conducted for 50 marks and reduced to 15)	: 15 marks

Regular assessment

Project report presentation and Technical presentation through PPT	: 7.5 marks
Listening Test	: 5 marks
Group discussion/mock job interview	: 7.5 marks
Resume submission	: 5 marks

End Semester Examination

Total Marks: 50, Time: 2 hrs.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. List down the ways in which gestures affect verbal communication.
2. Match the words and meanings

   Ambiguous promotion

   Bona fide referring to whole

   Holistic not clear

   Exaltation genuine
3. Expand the following Compound Nouns - a. Water supply. b. Object recognition. c. Steam turbine

Course Outcome 2 (CO2)

1. Read the passage below and prepare notes:

Mathematics, rightly viewed, possesses not only truth, but supreme beauty—a beauty cold and austere, like that of sculpture, without appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltation, the sense of being more than man, which is the touchstone of the highest excellence, is to be found in mathematics as surely as in poetry. What is best in mathematics deserves not merely to be learnt as a task, but to be assimilated as a part of daily thought, and brought again and again before the mind with ever-renewed encouragement. Real life is, to most men, a long second-best, a perpetual compromise between the ideal and the possible; but the world of pure reason knows no compromise, no practical limitations, no barrier to the creative activity embodying in splendid edifices the passionate aspiration after the perfect from which all great work springs. Remote from human passions, remote even from the pitiful facts of nature, the generations have gradually created an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulses can escape from the dreary exile of the actual world.

So little, however, have mathematicians aimed at beauty, that hardly anything in their work has had this conscious purpose. Much, owing to irrepressible instincts, which were better than avowed *beliefs, has been moulded by an unconscious taste; but much also has been spoilt by false notions of what was fitting. The characteristic excellence of mathematics is only to be found where the reasoning is rigidly logical: the rules of logic are to mathematics what those of structure are to architecture. In the most beautiful work, a chain of argument is presented in which every link is important on its own account, in which there is an air of ease and lucidity throughout, and the premises achieve more than would have been thought possible, by means which appear natural and inevitable. Literature embodies what is general in particular circumstances whose universal significance shines through their individual dress; but mathematics endeavours to present whatever is most general in its purity, without any irrelevant trappings.*

How should the teaching of mathematics be conducted so as to communicate to the learner as much as possible of this high ideal? Here experience must, in a great measure, be our guide; but some maxims may result from our consideration of the ultimate purpose to be achieved.

- From "On the teaching of mathematics" – Bertrand Russell

2. Enumerate the advantages and disadvantages of speed reading. Discuss how it can impact comprehension.

Course Outcome 3(CO3):

1. What are the key elements of a successful presentation?
2. Elucidate the importance of non-verbal communication in making a presentation
3. List out the key components in a technical presentation.

Course Outcome 4 (CO4):

1. Discuss: 'In today's world, being a good listener is more important than being a good Speaker.'
2. Listen to a video/live group discussion on a particular topic, and prepare a brief summary of the proceedings.
3. List the do's and don'ts in a group discussion.

Course Outcome 5 (CO5):

1. Watch a movie clip and write the subtitles for the dialogue.
2. What do you mean by barriers to effective listening? List ways to overcome each of these.
3. What are the different types of interviews? How are listening skills particularly important in Skype/telephonic interviews?

Course Outcome 6 (CO6):

1. Explain the basic structure of a technical report.
2. You have been offered an internship in a much sought-after aerospace company and are very excited about it. However, the dates clash with your series tests. Write a letter to the Manager – University Relations of the company asking them if they can change the dates to coincide with your vacation.
3. You work in a well-reputed aerospace company as Manager – University Relations. You are in charge of offering internships. A student has sent you a letter requesting you to change the dates allotted to him since he has series exams at that time. But there are no vacancies available during the period he has requested for. Compose an e-mail informing him of this and suggest that he try to arrange the matter with his college.

Syllabus

Module 1

Use of language in communication: Significance of technical communication Vocabulary Development: technical vocabulary, vocabulary used in formal letters/emails and reports, sequence words, misspelled words, compound words, finding suitable synonyms, paraphrasing, verbal analogies. Language Development: subject-verb agreement, personal passive voice, numerical adjectives, embedded sentences, clauses, conditionals, reported speech, active/passive voice.

Technology-based communication: Effective email messages, slide presentations, editing skills using software. Modern day research and study skills: search engines, repositories, forums such as Git Hub, Stack Exchange, OSS communities (MOOC, SWAYAM, NPTEL), and Quora; Plagiarism

Module 2

Reading, Comprehension, and Summarizing: Reading styles, speed, valuation, critical reading, reading and comprehending shorter and longer technical articles from journals, newspapers, identifying the various transitions in a text, SQ3R method, PQRST method, speed reading. Comprehension: techniques, understanding textbooks, marking and underlining, Note-taking: recognizing non-verbal cues.

Module 3

Oral Presentation: Voice modulation, tone, describing a process, Presentation Skills: Oral presentation and public speaking skills, business presentations, Preparation: organizing the material, self-Introduction, introducing the topic, answering questions, individual presentation practice, presenting visuals effectively.

Debate and Group Discussions: introduction to Group Discussion (GD), differences between GD and debate; participating GD, understanding GD, brainstorming the topic, questioning and clarifying, GD strategies, activities to improve GD skills

Module 4

Listening and Interview Skills Listening: Active and Passive listening, listening: for general content, to fill up information, intensive listening, for specific information, to answer, and to understand. Developing effective listening skills, barriers to effective listening, listening to longer technical talks, listening to classroom lectures, talks on engineering /technology, listening to documentaries and making notes, TED talks.

Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online (skype) interviews, one-to-one interview & panel interview, FAQs related to job interviews

Module 5

Formal writing: Technical Writing: differences between technical and literary style. Letter Writing (formal, informal and semi formal), Job applications, Minute preparation, CV preparation (differences between Bio-Data, CV and Resume), and Reports. Elements of style, Common Errors in Writing: describing a process, use of sequence words, Statements of Purpose, Instructions, Checklists.

Analytical and issue-based Essays and Report Writing: basics of report writing; Referencing Style (IEEE Format), structure of a report; types of reports, references, bibliography.

Lab Activities

Written: Letter writing, CV writing, Attending a meeting and Minute Preparation, Vocabulary Building
Spoken: Phonetics, MMFS (Multimedia Feedback System), Mirroring, Elevator Pitch, telephone etiquette, qualities of a good presentation with emphasis on body language and use of visual aids.
Listening: Exercises based on audio materials like radio and podcasts. Listening to Song. practice and exercises.
Reading: Speed Reading, Reading with the help of Audio Visual Aids, Reading Comprehension Skills
Mock interview and Debate/Group Discussion: concepts, types, Do's and don'ts- intensive practice

Reference Books

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
2. Meenakshi Raman and Sangeetha Sharma,"Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011
3. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
4. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
5. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
6. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.
7. Goodheart-Willcox, "Professional Communication", First Edition , 2017.
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015.
9. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013.
10. Anand Ganguly, "Success in Interview", RPH, 5th Edition, 2016.
11. Raman Sharma, "Technical Communications", Oxford Publication, London, 2004.

EST 102	PROGRAMING IN C	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	2	1	2	4	2019

Preamble: The syllabus is prepared with the view of preparing the Engineering Graduates capable of writing readable C programs to solve computational problems that they may have to solve in their professional life. The course content is decided to cover the essential programming fundamentals which can be taught within the given slots in the curriculum. This course has got 2 Hours per week for practicing programming in C. A list showing 24 mandatory programming problems are given at the end. The instructor is supposed to give homework/assignments to write the listed programs in the rough record as and when the required theory part is covered in the class. The students are expected to come prepared with the required program written in the rough record for the lab classes.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Analyze a computational problem and develop an algorithm/flowchart to find its solution
CO 2	Develop readable* C programs with branching and looping statements, which uses Arithmetic, Logical, Relational or Bitwise operators.
CO 3	Write readable C programs with arrays, structure or union for storing the data to be processed
CO 4	Divide a given computational problem into a number of modules and develop a readable multi-function C program by using recursion if required, to find the solution to the computational problem
CO 5	Write readable C programs which use pointers for array processing and parameter passing
CO 6	Develop readable C programs with files for reading input and storing output

readable* - readability of a program means the following:

1. Logic used is easy to follow
2. Standards to be followed for indentation and formatting
3. Meaningful names are given to variables
4. Concise comments are provided wherever needed

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓	✓		✓				✓	✓	✓
CO2	✓	✓	✓	✓	✓					✓		✓
CO3	✓	✓	✓	✓	✓					✓		✓
CO4	✓	✓	✓	✓	✓					✓	✓	✓
CO5	✓	✓			✓					✓		✓
CO6	✓	✓			✓					✓		✓

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination Marks**
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	15	10	25
Understand	10	15	25
Apply	20	20	40
Analyse	5	5	10
Evaluate			
Create			

Mark distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test 1 (for theory, for 2 hrs)	: 20 marks
Continuous Assessment Test 2 (for lab, internal examination, for 2 hrs)	: 20 marks

Internal Examination Pattern: There will be two parts; Part A and Part B. Part A contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), having 3 marks for each question. Students should answer all questions. Part B also contains 5 questions with 2 questions from each module (2.5 modules x 2 = 5), of which a student should answer any one. The questions should not have sub-divisions and each one carries 7 marks.

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1): Write an algorithm to check whether largest of 3 natural numbers is prime or not. Also, draw a flowchart for solving the same problem.

Course Outcome 2 (CO2): Write an easy to read C program to process a set of n natural numbers and to find the largest even number and smallest odd number from the given set of numbers. The program should not use division and modulus operators.

Course Outcome 3(CO3): Write an easy to read C program to process the marks obtained by n students of a class and prepare their rank list based on the sum of the marks obtained. There are 3 subjects for which examinations are conducted and the third subject is an elective where a student is allowed to take any one of the two courses offered.

Course Outcome 4 (CO4): Write an easy to read C program to find the value of a mathematical function f which is defined as follows. f(n) = n! / (sum of factors of n), if n is not prime and f(n) = n! / (sum of digits of n), if n is prime.

Course Outcome 5 (CO5): Write an easy to read C program to sort a set of n integers and to find the number of unique numbers and the number of repeated numbers in the given set of numbers. Use a function which takes an integer array of n elements, sorts the array using the Bubble Sorting Technique and returns the number of unique numbers and the number of repeated numbers in the given array.

Course Outcome 6 (CO6): Write an easy to read C program to process a text file and to print the Palindrome words into an output file.

Model Question paper

QP CODE: PAGES:3

Reg No:_______________

Name :_______________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIRST SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

***Course Code:* EST 102**

Course Name: Programming in C (Common to all programs)

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Write short note on processor and memory in a computer.
2. What are the differences between compiled and interpreted languages? Give example for each.
3. Write a C program to read a Natural Number through keyboard and to display the reverse of the given number. For example, if "3214567" is given as input, the output to be shown is "7654123".
4. Is it advisable to use *goto* statements in a C program? Justify your answer.
5. Explain the different ways in which you can *declare & initialize* a single dimensional array.
6. Write a C program to read a sentence through keyboard and to display the count of white spaces in the given sentence.
7. What are the advantages of using functions in a program?
8. With a simple example program, explain *scope* and *life time* of variables in C.
9. Write a function in C which takes the address of a single dimensional array (containing a finite sequence of numbers) and the number of numbers stored in the array as arguments and stores the numbers in the same array in reverse order. Use pointers to access the elements of the array.
10. With an example, explain the different modes of opening a file. (10x3=30)

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. (a) Draw a flow chart to find the position of an element in a given sequence, using linear searching technique. With an example explain how the flowchart finds the position of a given element. **(10)**

    (b) Write a pseudo code representing the flowchart for linear searching. **(4)**

OR

12. (a) With the help of a flow chart, explain the bubble sort operation. Illustrate with an example. **(10)**

    (b) Write an algorithm representing the flowchart for bubble sort. **(4)**

13. (a) Write a C program to read an English Alphabet through keyboard and display whether the given Alphabet is in upper case or lower case. **(6)**

    (b) Explain how one can use the builtin function in C, *scanf*to read values of different data types. Also explain using examples how one can use the builtin function in C, *printf*for text formatting. **(8)**

OR

14. (a) With suitable examples, explain various operators in C. (10)

    (b) Explain how characters are stored and processed in C. **(4)**

15. (a) Write a function in C which takes a 2-Dimensional array storing a matrix of numbers and the order of the matrix (number of rows and columns) as arguments and displays the sum of the elements stored in each row. **(6)**

    (b) Write a C program to check whether a given matrix is a diagonal matrix. **(8)**

OR

16. (a) Without using any builtin string processing function like *strlen*, *strcat* etc., write a program to concatenate two strings. **(8)**

    (b) Write a C program to perform bubble sort. **(6)**

17. (a) Write a function namely *myFact* in C to find the factorial of a given number. Also, write another function in C namely*nCr* which accepts two positive integer parameters *n* and *r* and returns the value of the mathematical function*C(n,r)*(n! / (r! x (n - r)!)). The function *nCr* is expected to make use of the factorial function *myFact.* *(10)*

    (b) What is recursion? Give an example. **(4)**

OR

18. (a) With a suitable example, explain the differences between a structure and a union in C. **(6)**

    (b) Declare a structure namely *Student* to store the details (*roll number, name, mark_for_C*) of a student. Then, write a program in C to find the average mark obtained by the students in a class for the subject *Programming in C* (using the field *mark_for_C*). Use array of structures to store the required data **(8)**

19. (a) With a suitable example, explain the concept of pass by reference. **(6)**

    (b) With a suitable example, explain how pointers can help in changing the content of a single dimensionally array passed as an argument to a function in C. **(8)**

OR

20. (a) Differentiate between sequential files and random access files? **(4)**

(b) Using the prototypes explain the functionality provided by the following functions. (10)

rewind()

i. *fseek()*

ii. *ftell()*

iii. *fread()*

iv. *fwrite()* ***(14X5=70)***

SYLLABUS

Programming in C (Common to all disciplines)

Module 1

Basics of Computer Hardware and Software

Basics of Computer Architecture: processor, Memory, Input& Output devices

Application Software & System software: Compilers, interpreters, High level and low level languages

Introduction to structured approach to programming, Flow chart Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)

Module 2

Program Basics

Basic structure of C program: Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf

Operators and Expressions: Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, size of operator, Assignment operators and Bitwise Operators. Operators Precedence

Control Flow Statements: If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.(Simple programs covering control flow)

Module 3

Arrays and strings

Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array

String processing: In built String handling functions (strlen, strcpy, strcat and strcmp, puts, gets)

Linear search program, bubble sort program, simple programs covering arrays and strings

Module 4

Working with functions

Introduction to modular programming, writing functions, formal parameters, actual parameters Pass by Value, Recursion, Arrays as Function Parameters structure, union, Storage Classes, Scope and life time of variables, *simple programs using functions*

Module 5

Pointers and Files

Basics of Pointer: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect

File Operations: open, close, read, write, append

Sequential access and random access to files: In built file handlingfunctions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*), *simple programs covering pointers and files.*

Text Books

1. Schaum Series, Gottfried B.S.,Tata McGraw Hill,Programming with C
2. E. Balagurusamy, Mcgraw Hill,Programming in ANSI C
3. Asok N Kamthane, Pearson,Programming in C
4. Anita Goel, Pearson, Computer Fundamentals

Reference Books

1. Anita Goel and Ajay Mittal, Pearson, Computer fundamentals and Programming in C
2. Brian W. Kernighan and Dennis M. Ritchie, Pearson, C Programming Language
3. Rajaraman V, PHI, Computer Basics and Programming in C
4. Yashavant P, Kanetkar, BPB Publications, Let us C

Course Contents and Lecture Schedule

Module 1: Basics of Computer Hardware and Software		**(7 hours)**
1.1	**Basics of Computer Architecture:** Processor, Memory, Input& Output devices	**2 hours**
1.2	**Application Software & System software:** Compilers, interpreters, High level and low level languages	**2 hours**
1.3	Introduction to structured approach to programming, Flow chart	**1 hours**
1.4	Algorithms, Pseudo code (*bubble sort, linear search - algorithms and pseudocode*)	**2 hours**
Module 2: Program Basics		**(8 hours)**
2.1	**Basic structure of C program:** Character set, Tokens, Identifiers in C, Variables and Data Types , Constants, Console IO Operations, printf and scanf	**2 hours**
2.2	**Operators and Expressions:** Expressions and Arithmetic Operators, Relational and Logical Operators, Conditional operator, sizeof operator, Assignment operators and Bitwise Operators. Operators Precedence	**2 hours**

2.3	**Control Flow Statements:** If Statement, Switch Statement, Unconditional Branching using goto statement, While Loop, Do While Loop, For Loop, Break and Continue statements.*(Simple programs covering control flow)*	**4 hours**
Module 3: Arrays and strings:		**(6 hours)**
3.1	Arrays Declaration and Initialization, 1-Dimensional Array, 2-Dimensional Array	**2 hours**
3.2	**String processing:** In built String handling functions(*strlen, strcpy, strcat and strcmp, puts, gets*)	**2 hours**
3.3	Linear search program, bubble sort program, *simple programs covering arrays and strings*	**3 hours**
Module 4: Working with functions		**(7 hours)**
4.1	Introduction to modular programming, writing functions, formal parameters, actual parameters	**2 hours**
4.2	Pass by Value, Recursion, Arrays as Function Parameters	**2 hours**
4.3	structure, union, Storage Classes,Scope and life time of variables, *simple programs using functions*	**3 hours**
Module 5: Pointers and Files		**(7 hours)**
5.1	**Basics of Pointer**: declaring pointers, accessing data though pointers, NULL pointer,array access using pointers, pass by reference effect	**3 hours**
5.2	**File Operations**: open, close, read, write, append	1 **hours**
5.3	**Sequential access and random access to files:** In built file handlingfunctions (*rewind() ,fseek(), ftell(), feof(), fread(), fwrite()*)**,** *simple programs covering pointers and files.*	**2 hours**

C PROGRAMMING LAB (Practical part of EST 102, Programming in C)

Assessment Method: The Academic Assessment for the Programming lab should be done internally by the College. The assessment shall be made on 50 marks and the mark is divided as follows: Practical Records/Outputs - 20 marks (internal by the College), Regular Lab Viva - 5 marks (internal by the College), Final Practical Exam – 25 marks (internal by the College).

The mark obtained out of 50 will be converted into equivalent proportion out of 20 for CIE computation.

LIST OF LAB EXPERIMENTS

1. Familiarization of Hardware Components of a Computer

2. Familiarization of Linux environment – How to do Programming in C with Linux

3. Familiarization of console I/O and operators in C

i) Display “Hello World”

ii) Read two numbers, add them and display theirsum

iii) Read the radius of a circle, calculate its area and display it

iv)Evaluate the arithmetic expression ((a -b / c * d + e) * (f +g)) and display its solution.Read the values of the variables from the user through console.

4. Read 3 integer values and find the largest amoung them.

5. Read a Natural Number and check whether the number is prime or not

6. Read a Natural Number and check whether the number is Armstrong or not

7. Read n integers, store them in an array and find their sum and average

8. Read n integers, store them in an array and search for an element in the array using an algorithm for Linear Search

9. Read n integers, store them in an array and sort the elements in the array using Bubble Sort algorithm

10**.** Read a string (word), store it in an array and check whether it is a palindrome word or not.

11. Read two strings (each one ending with a $ symbol), store them in arrays and concatenate them without using library functions.

12. Read a string (ending with a $ symbol), store it in an array and count the number of vowels, consonants and spaces in it.

13. Read two input each representing the distances between two points in the Euclidean space, store these in structure variables and add the two distance values.

14. Using structure, read and print data of n employees (*Name, Employee Id and Salary*)

15. Declare a union containing 5 string variables (*Name, House Name, City Name, State and Pin code*) each with a length of C_SIZE (user defined constant). Then, read and display the address of a person using a variable of the union.

16. Find the factorial of a given Natural Number n usingrecursive and non recursive functions

17. Read a string (word), store it in an array and obtain its reverse by using a user defined function.

18. Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to (i) read a matrix, (ii) find the sum of two matrices, (iii) find the product of two matrices, (i) find the transpose of a matrix and (v) display a matrix.

19. Do the following using pointers

i) add two numbers

ii) swap two numbers using a user defined function

20. Input and Print the elements of an array using pointers

21. Compute sum of the elements stored in an array using pointers and user defined function.

22. Create a file and perform the following

iii) Write data to the file

iv) Read the data in a given file & display the file content on console

v) append new data and display on console

23. Open a text input file and count number of characters, words and lines in it; and store the results in an output file.

PHL 120	ENGINEERING PHYSICS LAB	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		BSC	0	0	2	1	2019

Preamble: The aim of this course is to make the students gain practical knowledge to co-relate with the theoretical studies and to develop practical applications of engineering materials and use the principle in the right way to implement the modern technology.

Prerequisite: Higher secondary level Physics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop analytical/experimental skills and impart prerequisite hands on experience for engineering laboratories
CO 2	Understand the need for precise measurement practices for data recording
CO 3	Understand the principle, concept, working and applications of relevant technologies and comparison of results with theoretical calculations
CO 4	Analyze the techniques and skills associated with modern scientific tools such as lasers and fiber optics
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and by interpreting the results

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3				3			1	2			1
CO 2	3				3			1	2			1
CO 3	3				3			1	2			1
CO 4	3				3			1	2			1
CO 5	3				3			1	2			1

Mark distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration(Internal)**
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS

(Minimum 8 experiments should be completed)

1. CRO-Measurement of frequency and amplitude of wave forms
2. Measurement of strain using strain gauge and wheatstone bridge
3. LCR Circuit – Forced and damped harmonic oscillations
4. Melde's string apparatus- Measurement of frequency in the transverse and longitudinal mode
5. Wave length measurement of a monochromatic source of light using Newton's Rings method.
6. Determination of diameter of a thin wire or thickness of a thin strip of paper using air wedge method.
7. To measure the wavelength using a millimeter scale as a grating.
8. Measurement of wavelength of a source of light using grating.
9. Determination of dispersive power and resolving power of a plane transmission grating
10. Determination of the particle size of lycopodium powder
11. Determination of the wavelength of He-Ne laser or any standard laser using diffraction grating
12. Calculate the numerical aperture and study the losses that occur in optical fiber cable.
13. I-V characteristics of solar cell.
14. LED Characteristics.
15. Ultrasonic Diffractometer- Wavelength and velocity measurement of ultrasonic waves in a liquid
16. Deflection magnetometer-Moment of a magnet- Tan A position.

Reference books

1. S.L.Gupta and Dr.V.Kumar, "Practical physics with viva voice", Pragati PrakashanPublishers, Revised Edition, 2009
2. M.N.Avadhanulu, A.A.Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand&Co,2008
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014
4. P. R. Sasikumar "Practical Physics", PHI Ltd., 2011.

CYL 120	ENGINEERING CHEMISTRY LAB	CATEGORY	L	T	P	CREDIT
		BSC	0	0	2	1

Preamble: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters

Prerequisite: Experiments in chemistry introduced at the plus two levels in schools

Course outcomes: After the completion of the course the students will be able to

CO 1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO 2	Develop skills relevant to synthesize organic polymers and acquire the practical skill to use TLC for the identification of drugs
CO 3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO 4	Acquire the ability to understand, explain and use instrumental techniques for chemical analysis
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO 6	Function as a member of a team, communicate effectively and engage in further learning. Also understand how chemistry addresses social, economical and environmental problems and why it is an integral part of curriculum

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3				2							3
CO 2	3				3							3
CO 3	3				3							3
CO 4	3				3							3
CO 5	3				1							3
CO 6	3				1							3

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

LIST OF EXPERIMENTS (MINIMUM 8 MANDATORY)

1. Estimation of total hardness of water-EDTA method
2. Potentiometric titration
3. Determination of cell constant and conductance of solutions.
4. Calibration of pH meter and determination of pH of a solution
5. Estimation of chloride in water
6. Identification of drugs using TLC
7. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} in solution
8. Determination of molar absorptivity of a compound ($KMnO_4$ or any water soluble food colorant)
9. Synthesis of polymers (a) Urea-formaldehyde resin (b) Phenol-formaldehyde resin
10. Estimation of iron in iron ore
11. Estimation of copper in brass
12. Estimation of dissolved oxygen by Winkler's method
13. (a) Analysis of IR spectra (minimum 3 spectra) (b) Analysis of ^1H NMR spectra (minimum 3 spectra)
14. Flame photometric estimation of Na^+ to find out the salinity in sand
15. Determination of acid value of a vegetable oil
16. Determination of saponification of a vegetable oil

Reference Books

1. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
2. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
3. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
4. Ahad J., "Engineering Chemistry Lab manual", Jai Publications, 2019.
5. Roy K Varghese, "Engineering Chemistry Laboratory Manual", Crownplus Publishers, 2019.
6. Soney C George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd, New Delhi, 2019.

ESL 120	CIVIL & MECHANICAL WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
			0	0	2	1	2019

Preamble: The course is designed to train the students to identify and manage the tools, materials and methods required to execute an engineering project. Students will be introduced to a team working environment where they develop the necessary skills for planning, preparing and executing an engineering project.

To enable the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to:

Course Outcome	Course Outcome Description
CO 1	Name different devices and tools used for civil engineering measurements
CO 2	Explain the use of various tools and devices for various field measurements
CO 3	Demonstrate the steps involved in basic civil engineering activities like plot measurement, setting out operation, evaluating the natural profile of land, plumbing and undertaking simple construction work.
CO 4	Choose materials and methods required for basic civil engineering activities like field measurements, masonry work and plumbing.
CO 5	Compare different techniques and devices used in civil engineering measurements
CO 6	Identify Basic Mechanical workshop operations in accordance with the material and objects
CO 7	Apply appropriate Tools and Instruments with respect to the mechanical workshop trades
CO 8	Apply appropriate safety measures with respect to the mechanical workshop trades

Mapping of course outcomes with program outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	-	-	-	1	1	-	-	2	2	-	-
CO 2	1	-	-	-	1	1	-	-	2	2	-	-
CO 3	1	-	-	-	1	1	-	2	2	2	1	-
CO 4	1	-	-	-	1	1	-	2	2	2	1	1
CO 5	1	-	-	-	1	1	-	-	2	2		1
CO 6	2											

CO 7	2											
CO 8	2											

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
100	70	30	1 hour

Assessment Procedure: Total marks allotted for the course is 100 marks. CIE shall be conducted for 70 marks and ESE for 30 marks. CIE should be done for the work done by the student and also viva voce based on the work done on each practical session. ESE shall be evaluated by written examination of one hour duration conducted internally by the institute.

Continuous Internal Evaluation Pattern:

Attendance : 20 marks
Class work/ Assessment /Viva-voce : 50 marks
End semester examination (Internally by college) : 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

SYLLABUS

PART 1

CIVIL WORKSHOP

Exercise 1. Calculate the area of a built-up space and a small parcel of land- Use standard measuring tape and digital distance measuring devices

Exercise 2. (a) Use screw gauge and vernier calliper to measure the diameter of a steel rod and thickness of a flat bar

(b) Transfer the level from one point to another using a water level

(c) Set out a one room building with a given plan and measuring tape

Exercise 3. Find the level difference between any two points using dumpy level

Exercise 4. (a) Construct a $1\frac{1}{2}$ thick brick wall of 50 cm height and 60 cm length using English bond. Use spirit level to assess the tilt of walls.

(b) Estimate the number of different types of building blocks to construct this wall.

Exercise 5. (a) Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves ,fixtures and sanitary fittings.

(b) Install a small rainwater harvesting installation in the campus

Reference Books:

1. Khanna P.N, “Indian Practical Civil Engineering Handbook”, Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications
4. S. C. Rangwala, “Engineering Materials,” Charotar Publishing House.

PART II

MECHANICAL WORKSHOP

LIST OF EXERCISES

(Minimum EIGHT units mandatory and FIVE models from Units 2 to 8 mandatory)

UNIT 1:- General : Introduction to workshop practice, Safety precautions, Shop floor ethics, Basic First Aid knowledge.

Study of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc.

UNIT 2:- Carpentry : Understanding of carpentry tools

Minimum any one model

1. T –Lap joint 2. Cross lap joint 3. Dovetail joint 4. Mortise joints

UNIT 3:- Foundry : Understanding of foundry tools

Minimum any one model

1.Bench Molding 2. Floor Molding 3. Core making 4. Pattern making

UNIT 4: - Sheet Metal : Understanding of sheet metal working tools

Minimum any one model

1. Cylindrical shape
2. Conical shape
3. Prismatic shaped job from sheet metal

UNIT 5: - Fitting : Understanding of tools used for fitting

Minimum any one model

1. Square Joint
2. V- Joint
3. Male and female fitting

UNIT 6: - Plumbing : Understanding of plumbing tools, pipe joints

Any one exercise on joining of pipes making use of minimum three types of pipe joints

UNIT 7: - Smithy: Understanding of tools used for smithy.

Demonstrating the forge-ability of different materials (MS, Al, alloy steel and cast steels) in cold and hot states.

Observing the qualitative difference in the hardness of these materials

Minimum any one exercise on smithy

1. Square prism
2. Hexagonal headed bolt
3. Hexagonal prism
4. Octagonal prism

UNIT 8: -Welding: Understanding of welding equipments

Minimum any one welding practice

Making Joints using electric arc welding. bead formation in horizontal, vertical and over head positions

UNIT 9: - Assembly: Demonstration only

Dissembling and assembling of

1. Cylinder and piston assembly
2. Tail stock assembly
3. Bicycle
4. Pump or any other machine

UNIT 10: - Machines: Demonstration and applications of the following machines

Shaping and slotting machine; Milling machine; Grinding Machine; Lathe; Drilling Machine.

UNIT 11: - Modern manufacturing methods: Power tools, CNC machine tools, 3D printing, Glass cutting.

Course Contents and Lecture Schedule:

No	Topic	No of Sessions
1	**INTRODUCTION**	
1.1	Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: (a) Tools: screw drivers, spanners, Allen keys, cutting pliers etc and accessories (b) bearings, seals, O-rings, circlips, keys etc	1
2	**CARPENTRY**	
2.1	Understanding of carpentry tools and making minimum one model	2

3	**FOUNDRY**	
3.1	Understanding of foundry tools and making minimum one model	2
4	**SHEET METAL**	
4.1	Understanding of sheet metal working tools and making minimum one model	2
5	**FITTING**	
5.1	Understanding of fitting tools and making minimum one model	2
6	**PLUMBING**	
6.1	Understanding of pipe joints and plumbing tools and making minimum one model	2
7	**SMITHY**	
7.1	Understanding of smithy tools and making minimum one model	2
8	**WELDING**	
8.1	Understanding of welding equipments and making minimum one model	2
9	**ASSEMBLY**	
9.1	Demonstration of assembly and dissembling of multiple parts components	1
10	**MACHINES**	
10.1	Demonstration of various machines	1
11	**MODERN MANUFACTURING METHODS**	
11.1	Demonstrations of: power tools, CNC Machine tools, 3D printing, Glass cutting	1

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings
CO 4	Identify and test various electronic components
CO 5	Draw circuit schematics with EDA tools
CO 6	Assemble and test electronic circuits on boards
CO 7	Work in a team with good interpersonal skills

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2
CO 4	3	-	-	-	-	-	-	-	-	-	-	2
CO 5	3	-	-	-	2	-	-	-	-	-	-	2
CO 6	3	-	-	-	2	-	-	-	-	-	-	1
CO 7	-	-	-	-	-	-	-	-	3	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus

PART 1

ELECTRICAL

List of Exercises / Experiments

1. a) Demonstrate the precautionary steps adopted in case of Electrical shocks.

   b)Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications.

   b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

PART II

ELECTRONICS

List of Exercises / Experiments (Minimum of 7 mandatory)

1. Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

2. Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia or XCircuit), Interpret data sheets of discrete components and IC's, Estimation and costing.

3. Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]

4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.]

5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB, Crimping.]

6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]
7. Assembling of electronic circuits using SMT (Surface Mount Technology) stations.
8. Assembling of electronic circuit/system on general purpose PCB, test and show the functioning (**Any Two circuits).**

   1. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
   2. Square wave generation using IC 555 timer in IC base.
   3. Sine wave generation using IC 741 OP-AMP in IC base.
   4. RC coupled amplifier with transistor BC107.

SEMESTER -3

BTT201	BIOPROCESS CALCULATIONS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: To familiarise with material and energy balances that is very important for the designing and functioning of bioprocess plants

Prerequisite: Basic knowledge about percentage and fractions, Units and conversions, Molarity, normality, Gas laws

Course Outcomes: After the completion of the course the student will be able to

CO 1	Use an appropriate system of units for quantities in engineering problem solving.
CO 2	Solve the material balance and energy balance equations for unit operations and unit processes in bioprocess engineering
CO 3	Formulate growth medium based on stoichiometry and elemental balances.
CO 4	Calculate heat of reaction for microbial growth and product formation

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3		-	-	-	-	-	1	-	-	1
CO 2	2	3	1	-	-	-	-	-	2	-	-	2
CO 3	2	3	1	-	-	-	-	-	-	-	-	-
CO 4	2	3	1	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Use appropriate system of units for quantities in engineering problem solving.

1. The pressure reading from a barometer is 742 mm Hg. Express this reading in kilopascals, kPa.

2. Density of water = ----- g/cm^3 = ---- kg/liter = --- ton/m^3

3. The average commercial jet flies around an altitude of 32,500 feet. How high is this in meters?

Course Outcome 2 (CO2): Solve the material balance and energy balance equations for unit operations and unit processes in bioprocess engineering

1. A soap plant produces raw soap containing 50% moisture. This is to be dried to 20% moisture before it is pressed into cakes for sale. How many 100g soap pieces can be obtained from 1000 Kg of original raw soap?

2. A weak acid containing 12.5% H_2SO_4 and the rest water is fortified by adding 500Kg of concentrated acid containing 80% H_2SO_4. Determine the amount of the solution obtained if it contains 18.5% H_2SO_4.
3. Gas analyzing CO_2 -5.5 %, CO- 25%, H_2 -14%, N_2 -55%, CH_4 - 0.5% is burned in furnace with 10% excess air. Calculate the Orset analysis of the flue gas

Course Outcome 3(CO3):Formulate growth medium based on stoichiometry and elemental balances.

1. The aerobic degradation of Benzoic acid by mixed culture can be represented by

following reaction: $C_6H_5COOH + a\ O_2 + b\ NH_3 c C_5H_7O_2N + d\ H_2O + e\ CO_2$. Find the

stoichiometric coefficients where RQ value is 0.9.

2. Write a note on thermodynamics of microbial growth

3. The growth of yeast cells on glucose under anaerobic conditions can be described by the following equation:

$C_6H_{12}O_6 + a\ NH_3 \quad 0.59CH_{1.74}N_{0.2}\ O\ 0._{45} + 1.3C_2H_5OH + bC_3H_8O_3 + 1.54\ CO_2 + 0.036H_2O$

(i)Determine the stoichiometric coefficients a and b.

Course Outcome 4 (CO4): Calculate heat of reaction for microbial growth and product formation

1. Explain how degrees of reduction is useful in finding out stoichiometric coefficients.
2. Find out degrees of reduction for the following Methanol, ethanol,CO 2 ,Ammonia and glucose?(5)
3. Explain how a degree of reduction is useful in finding out stoichiometric coefficients.

Model Question paper

			Total Pages:
Reg No.:______________		Name:__________________________	
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__			
Course Code: BTT201			
Course Name: BIOPROCESS CALCULATIONS			
Max. Marks: 100			Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	State Ideal Gas Law
	b)	How many moles of solute are contained in 3 L of 2 M solution?
	c)	Differentiate between unit operations and unit processes.
	d)	Describe about steady state, batch and continuous process
	e)	Wood containing 40% moisture is dried to 5% moisture. What mass of water in kilograms is evaporated per kg of dry wood?
	f)	Compare Bypass and recycle operations with neat sketch
	g)	Explain the following: (i)Yield, (ii)Conversion,(iii)Degree of completion

	h)	For the purpose of most engg calculations, air is assumed to be composed of 21 mol% O_2 and 79 mol% N_2. Calculate the average mol.wt.of air?	
	i)	A compound whose molecular weight is 103, has the following composition, C-81.5%, H-4.9%, N- 13.9% . What is the formula?	
	j)	Calculate the degrees of reduction for (i)Ethanol,(ii) Methanol (iii) CO_2	
		PART B	
		Answer any one full question from each module. Each carries 14 marks.	
2	a)	Natural gas is piped from the well at 300 K and 400 kPa. The gas is found to contain 93% methane, 4.5% ethane and the rest nitrogen. Calculate the following: a. The partial pressure of nitrogen b. The pure-component volume of ethane in 10 m^3 of the gas c. The density at standard conditions in kg/m^3 d. The density of gas as piped in kg/m^3 e. The average molecular weight of gas	(10)
	b)	What is compressibility factor? Explain using the various compressibility charts?	(4)
		OR	
3	a)	What are humidity, Percent humidity and Dew point? Explain about relative humidity and percent humidity. Give a brief idea about the humidity chart.	(8)
	b)	Explain Raoults law and Henrys law	(6)
4	a)	List out steps for solving material balance problems.	(8)
	b)	Illustrate with an example, the energy balance in a cyclic process.	(6)
		OR	
5	a)	Wet sewage sludge enters a continuous thickener at a rate of 100 kg/h and dehydrated sludge leaves the thickener at a rate of 75 kg/h. Determine the amount of water removed in the thickener in one hour, assuming steady state operation.	(8)
	b)	Give the importance of the following concepts in solving material balance problems (i) Number of degrees of freedom and material balance equations. (ii) Key component.(iii) Selection of basis for calculations.	(6)
6		It is required to make 1000kg of mixed acid containing 60% H2SO4, 32% HNO3,8% H2O by blending the following.Spent acid containing 11.3% HNO3, 44.4% H2SO4, 44.3% H2O,ii)Concentrated HNO3 containing 90% HNO3, remaining H2O Concentrated H2SO4 containing 98% H2SO4, balance ,H2O. All this percentage is by weight. Calculate the quantity of each of the acids required for blending.	(14)
		OR	

7	a)	Soybean seeds are extracted with hexane in batch extractors. The flaked seed contains 20% oil, 68% solids and 12% moisture. At the end of the extraction, the cake is separated from the hexane – oil mixture. The cake analysis yields 0.8% oil, 88% solids and 11.2%moisture. Find the percentage recovery of oil.	(10)
	b)	Explain Absorption with necessary material balance equation	(4)
8		The following data was obtained during an analysis in a coal fired steam generator. The ultimate analysis of coal: 80.5% C, 4.6% H2, 5% O, 1.1 % N2 and 8.8% ash. No carbon is lost in the refuse. The Orsat analysis o the flue gas: 16.4 % CO2, 2.3% O2, 0.4% CO, 80.9% N2. Calculate the weight of dry gaseous products formed per 100 kg of coal fired.	(14)
		OR	
9	a)	Coal contains 85% carbon and 15 % ash. The cinder formed as a result of combustion of coal contains 80% ash and 20% carbon. Determine the weight of cinder formed by the combustion of 100 kg of coal.	(4)
	b)	Interpret the working and application of Orsatanalyzer with neat sketch	(10)
10		*Candida utilis*cells convert glucose to CO_2 and H_2O during growth. The cell composition is $CH_{1.84}O_{0.55}N_{0.2}$ plus 5% ash. Yield of biomass from substrate is 0.5 g g-1. Ammonia is used as a nitrogen source. What is the oxygen demand with growth compared to that without?	(14)
		OR	
11	a)	Corn steep liquor contains 2.5 % invert sugars and 50% water; the rest can be considered solids. Beet molasses contains 50% sucrose, 1% invert sugars, 18% water and the remaining solids is mixed with corn steep liquor in a mixing tank.Water is added to produce diluted sugar mixture 2% (w/w) invert sugars. An amount of 125 kg of corn steep liquor and 45 kg molasses are fed into the tank.Draw a schematic representation for the given system and calculate the following:i) How much water is required for the process?ii) What is the concentration of sucrose in the final mixture?	(10)
	b)	Explain theoretical oxygen demand and maximum possible yield.	(4)
		****	

Syllabus

Module 1

Fundamentals of Units and dimensions: Chemical arithmetic: Mole concept, atomic weight, molecular weight and equivalent weight.

Chemical composition: Methods of expressing compositions of mixtures and solutions- mole percent, mass percent, volume percent, molarity, molality, normality, ppm, density and specific gravity, specific gravity scales.

Use of mole concept in biological and chemical reactions, Ideal gas laws, gaseous mixtures, real gas laws, gas constant.Composition of gases on dry basis and on wet basis, Average molecular weight and density.Critical properties.

Humidity: Humidity and saturation: various terms associated with humidity and saturation. Use of Psychrometric charts and determination of humidity.

(A treatment using numerical examples on all the above topics is required)

Module 2

Fundamentals of material balances and energy balances:

Definition of unit operations and unit processes.

Law of conservation of mass, types of material balance problems – total and component balances, steady and unsteady state processes, batch and continuous processes. Concept of tie element, basis for calculations, independent material balance equations, degrees of freedom and steps for solving material balance problems.

(A treatment using numerical examples on all the above topics is required)

Fundamentals of energy balances: Law of conservation of energy, qualitative study of components of energy balance equations.

Module 3

Material balances without chemical reactions: Material balances for unit operations like evaporation, crystallization, drying, leaching, extraction, absorption and distillation. Qualitative study of bypass, recycle and purging operations

(A treatment using numerical examples on all the above topics is required)

Module 4

Material balances with chemical reactions: Definition of terms like limiting reactant, excess reactant, percentage yield and selectivity, extent of reaction:- simple numerical examples. Combustion of solid, liquid and gaseous fuels, heating value of fuels, proximate and ultimate analysis of coal, Orsat analysis. Qualitative treatment of Recycle and purge involving reactions

(A treatment using numerical examples on all the above topics is required)

Module 5

Stoichiometry of cell growth and product formation

Material and energy balances for sterilization, industrial fermentation and downstream processing, Waste treatment processes – simple numerical examples and case studies. Stoichiometry of cell growth and product formation: Overall growth stoichiometry- medium formulation and yield factors, Elemental material balances for growth, Electron balances, Product formation stoichiometry, Theoretical oxygen demand and maximum possible yield – simple numerical examples

(A treatment using numerical examples on all the above topics is required)

Text Books

1. K.V. Narayanan, B. Lakshmikutty, *Stoichiometry and Process Calculations*, Prentice Hall of India, 2006

2. Michael L Shuler &FikretKargi – *Bioprocess Engg. Basic Concepts* – Prentice – Hall India.

Reference Books

1. B.I. Bhatt, S.M. Vora, *Stoichiometry*, Fourth edition, Tata McGraw Hill, 2004.
2. Venkataramani&N.N.Ananthraman – *Process calculation* – Prentice Hall India.
3. David M. Himmelblau, James B. Riggs, *Basic Principles and Calculations in Chemical Engineering*, Prentice Hall, 2012.
4. Pauline M Doran, *Bioprocess Engineering Principles,* 2/e, Elsevier- Academic Press, 2013

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Fundamentals of Units and dimensions**	
1.1	Chemical arithmetic: Mole concept, atomic weight, molecular weight and equivalent weight. Use of mole concept in biological and chemical reactions,	1
1.2	Chemical composition: Methods of expressing compositions of	2

	mixtures and solutions- mole percent, mass percent, volume percent,	
1.3	Molarity, molality, normality, ppm,	1
1.4	Density and specific gravity, specific gravity scales.	1
1.5	Ideal gas laws, gaseous mixtures, real gas laws, gas constant.	2
1.6	Composition of gases on dry basis and on wet basis, Average molecular weight and density. Critical properties.	1
1.7	Humidity and saturation: various terms associated with humidity and saturation. Use of Psychrometric charts and determination of humidity.	1
2	**Module 2: Fundamentals of material balances and energy balances:**	
2.1	Definition of unit operations and unit processes.	1
2.2	Law of conservation of mass, types of material balance– total and component balances	1
2.3	steady and unsteady state processes, batch and continuous processes.	1
2.4	Concept of tie element, basis for calculations, independent material balance equations, degrees of freedom **Problem solving**	2
2.5	steps for solving material balance problems. **Problem solving**	1
2.6	Fundamentals of energy balances: Law of conservation of energy, qualitative study of components of energy balance equations.	1
3	**Material balances without chemical reactions**	
3.1	Material balances for evaporation and drying **Problem solving**	1
3.2	Material balances for crystallization **Problem solving**	2
3.3	Material balances for leaching **Problem solving**	1
3.4	Material balances for absorption **Problem solving**	1
3.5	Material balances for distillation **Problem solving**	1
3.6	Material balances for extraction **Problem solving**	2

3.7	Qualitative study of bypass, recycle and purging operations **Problem solving**	2
4	**Material balances with chemical reactions**	
4.1	Definition of terms like limiting reactant, excess reactant, percentage yield and selectivity, extent of reaction:-	1
4.2	Simple numerical examples.	1
4.3	Combustion of solid, liquid and gaseous fuels	1
4.4	Simple numerical examples.	2
4.5	Heating value of fuels,	1
4.6	Proximate and ultimate analysis of coal,	1
4.7	Orsat analysis.	2
4.8	Simple numerical examples.	1
4.9	Qualitative treatment of Recycle and purge involving reactions	1
5	**Stoichiometry of cell growth and product formation**	
5.1	Material and energy balances for sterilization,	1
5.2	industrial fermentation and downstream processing	1
5.3	Waste treatment processes – simple numerical examples and case studies.	1
5.4	Stoichiometry of cell growth and product formation: Overall growth stoichiometry- medium formulation and yield factors,	1
5.5	Elemental material balances for growth,	1
5.6	Electron balances,	1
5.7	Product formation stoichiometry,	1
5.8	Theoretical oxygen demand and maximum possible yield – simple numerical examples	1

BTT203	MICROBIOLOGY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: Familiarise with the characteristics and function of microorganisms which are helpful as well as harmful for life and its existence

Prerequisite: Nil

This course is a pre-requisite for gaining a fundamental understanding of microbe based bioprocess systems. This course shall equip the students in applying their knowledge of microorganisms to a variety of bioprocess situations, in all realms of human endeavour.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate the ability to visualize, cultivate and classify microorganisms
CO 2	Describe the diversity of microorganisms and methods to control their growth
CO 3	Demonstrate that microorganisms have a vital role in the environment
CO 4	Cite examples of the vital role of microorganisms in the industries important to human well being.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	2	2	-	2	2	-	-	-	-	-
CO 2	-	-	2	2	-	2	2	-	-	-	-	-
CO 3	-	-	2	2	-	3	3	-	-	-	-	-
CO 4	-	-	2	2	-	3	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State the features of eukaryotic cells.

2. Provide a classification scheme based on size, shape and arrangement of microorganisms.

3. Define the functionality of Scanning Electron Microscope.

Course Outcome 2 (CO2)

1. Illustrate the microbiological principles of Disinfection, Sanitization and Antisepsis

2. List the features of HEPA filter

3. Justify giving reasons the need to evaluate and assess the diversity of microorganisms

Course Outcome 3(CO3):

1. Describe Biogeochemical cycling with reference to Carbon cycle

2. Discuss on Microbial analysis of water purity

3. Illustrate the role of microorganisms in organic matter decomposition

Course Outcome 4 (CO4):

1. Narrate the role of microorganisms in food spoilage.

2. Signify the application of microbiology in Agriculture through Bio fertilization

3. Detail the microbial sources in preparation of Bio pesticide. Signify the application of microbiology in Human health through Biopesticides

Model Question paper

			Total Pages:
Reg No.:_______________		Name:__________________________	
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__			
Course Code: BTT203			
Course Name: MICROBIOLOGY			
Max. Marks: 100		Duration: 3 Hours	
PART A			

		Answer all questions, each carries 3 marks.
1	a)	What are the contributions of Robert Koch to the field of microbiology?
	b)	What is differential staining? Explain acid fast staining with examples.
	c)	Tabulate the differences between gram +ve and gram –ve bacterial cell wall structure with a neat labelled diagram and give two examples for gram +ve and –ve bacteria.
	d)	Give the importance of serial dilution. What are the techniques that can be used to obtain specific cultures in a pure form from a given environmental samples
	e)	Derive the mathematical expression for exponential growth phase.
	f)	Explain physical and chemical agents used for the control of microorganisms
	g)	What are extremophiles? Describe the effect of environmental factors on growth
	h)	Explain host pathogen interaction with an example

	i)	Mention the process for the production of any two fermented food products
	j)	Explain the various food infections caused by microorganisms. How is food infection different from food intoxication?

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Classify microorganisms based on their requirement for energy, carbon and electron source and describe the major nutritional groups with examples.	(14)
		OR	
3	a)	Discuss in detail the eukaryotic cellular features	(14)
4	a)	Define media. Discuss in detail the types of media	(6)
	b)	Detail the stepwise preparation of PDA media	(8)
		OR	
5		Define Numerical Aperture. Detail the principle and working of Bright field microscope	(14)
6	a)	Sketch and explain the Bacterial Growth curve	(6)
	b)	Signify the Bacterial growth curve giving reasons	(8)
		OR	
7		Define sterilization. Narrate the principle and working of dry heat method of sterilization	(14)
8		Explain the principle, procedure and expected results of IMViC series of tests	(14)
		OR	
9		What are extremophiles? Describe the effect of any four environmental factors on growth	(14)
10		Explain the role of microorganisms in the production of pesticides and insecticides	(14)
		OR	
11		Mention the process for the production of any two fermented food products	(14)

****

Syllabus

Historical aspects and the landmark discoveries of microbiology; microscopy and staining techniques. Eukaryotic and prokaryotic cell structure and function; microbial taxonomy; classification systems, Microbial nutrition and cultivation, Microbial growth and control of microorganisms. Microbial interactions and ecology; microorganisms in different environments- aquatic and soil. Application of microbiology.

Module 1:

Historical perspectives: Landmark discoveries relevant to the field of microbiology; Scope and relevance of microbiology.

Microbial taxonomy: Evolution and diversity of microorganisms, classification systems. Bacteria, archaea; Eukaryotic microbes: Fungi, algae, protozoa. Viruses, viroids and prions

Eukaryotic and prokaryotic cell structure and function: size, shape and arrangement, cell membranes, cell organelles, cell walls.

Module 2:

Microscopic techniques: light microscopy, dark field microscopy, phase contrast microscopy, fluorescence microscopy, SEM, TEM. **Staining techniques**: cell staining- simple staining, gram staining and acid fast staining; staining of specific structures.

Microbial nutrition and cultivation: Nutritional classes of microbes, Macro and micronutrients, sources and physiological functions of nutrients. Growth factors and their functions in metabolism

Cultivation of microorganisms: Culture media- synthetic, complex media, solidifying agents, types of media - selective, differential and enrichment media, pure culture methods - spread plate, pour plate and streak plate, special techniques for cultivation of anaerobes.

Module 3:

Microbial Growth: Definition of growth; growth curve; mathematical expression of exponential growth phase; measurement of growth and growth yields; synchronous growth; effect of environmental factors on growth.

Control of microorganisms: Basic terminology- sterilization, disinfection, sanitization, antisepsis. Physical methods for microbial control- heat, low temperature, filtration and radiation. Use of chemical agents, evaluation of effectiveness of antimicrobial agents

Microbial diseases – examples of bacterial diseases and host pathogen interaction

Module 4:

Microbial ecology: Biogeochemical cycles: cycles of nitrogen, carbon and sulphur

Microbiological analysis of water purity - sanitary tests for coliforms (presumptive test, confirmed test, completed test), MPN test, defined substrate test, IMVIC test. Quality standards for drinking water

Soil microbiology: Soil as a habitat for microorganisms, role of microorganisms in organic matter decomposition.

Module 5:

Application of microbiology: **Food microbiology:** Role of microorganisms in food spoilage and contamination, food preservation methods - physical and chemical methods, food borne diseases and intoxications, examples of fermented food products.

Industrial microbiology - Microorganisms as biofertilizers and biopesticides, commercially important microorganisms for industrial fermentation

Text Books

1. Prescott, Harley and Klein, *Microbiology*, McGraw Hill International Edition, 2008.
2. Pelczar M. J., E. C. E. Chan and N. R. Krieg, *Microbiology*, Tata McGraw Hill, 1993.

Reference Books

1.Ingraham J. L. and C. A. lngraham, *Introduction to Microbiology A Case History Approach,* 3/e, Thomson Publications, 2003.
2.Brock, *Biology of Microorganism*, Prentice Hall, International Inc, 2005.
3. Schlegel H. G., *General Microbiology*, Cambridge University Press, 1993.

Course Contents and Lecture Schedule

No		No. of Lectures
1	**Historical perspectives**	
1.1	Landmark discoveries relevant to the field of microbiology; Scope and relevance of microbiology.	3
1.2	**Microbial taxonomy**: Evolution and diversity of microorganisms, classification systems. Bacteria, archaea; Eukaryotic microbes: Fungi, algae, protozoa. Viruses, viroids and prions	3
1.3	**Eukaryotic and prokaryotic cell structure and function**: size, shape and arrangement, cell membranes, cell organelles, cell walls.	3
2	**Microscopic techniques**	
2.1	Light microscopy, dark field microscopy, phase contrast microscopy, fluorescence microscopy, SEM, TEM. **Staining techniques**: cell staining- simple staining, gram staining and acid fast staining; staining of specific structures.	4
2.2	**Microbial nutrition and cultivation**: Nutritional classes of microbes, Macro and micronutrients, sources and physiological	3

	functions of nutrients. Growth factors and their functions in metabolism	
2.3	**Cultivation of microorganisms**: Culture media- synthetic, complex media, solidifying agents, types of media - selective, differential and enrichment media, pure culture methods - spread plate, pour plate and streak plate, special techniques for cultivation of anaerobes.	3
3	**Microbial Growth**	
3.1	Definition of growth; growth curve; mathematical expression of exponential growth phase; measurement of growth and growth yields; synchronous growth; effect of environmental factors on growth.	3
3.2	**Control of microorganisms**: Basic terminology- sterilization, disinfection, sanitization, antisepsis. Physical methods for microbial control- heat, low temperature, filtration and radiation. Use of chemical agents, evaluation of effectiveness of antimicrobial agents	3
3.3	**Microbial diseases –** examples of bacterial diseases and host pathogen interaction	3
4	**Microbial ecology**	
4.1	Biogeochemical cycles: cycles of nitrogen, carbon and sulphur	3
4.2	**Microbiological analysis of water purity** - sanitary tests for coliforms (presumptive test, confirmed test, completed test), MPN test, defined substrate test, IMVIC test. Quality standards for drinking water	3
4.3	**Soil microbiology**: Soil as a habitat for microorganisms, role of microorganisms in organic matter decomposition	3
5	**Application of microbiology**	
5.1	**Food Microbiology:** Role of microorganisms in food spoilage and contamination, food preservation methods - physical and chemical methods, food borne diseases and intoxications, examples of fermented food products.	4
5.2	**Industrial Microbiology** - Microorganisms as biofertilizers and biopesticides, commercially important microorganisms for industrial fermentation	4

BTT205	FLUID FLOW AND PARTICLE TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: Enhance knowledge with momentum transfer mechanisms in industrial bioprocessing.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Compute the fluid properties associated with principles of fluid statics and dynamics of fluid flow.
CO 2	Use basic momentum and energy balance equations in specific domains of frictional flow/boundary layer flow of incompressible fluids in pipe flow.
CO 3	Explore the fluid moving machineries and principles of flow measurement in different flow metering equipments
CO 4	Examine the equipments for size reduction of solids, particle size analysis methods and solid liquid separation processes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	-	-	-	2	-	-	-	-	-	2
CO 2	3	3	2	-	-	2	-	-	-	-	-	-
CO 3	3	3	2	-	-	2	-	-	-	-	-	2
CO 4	3	3	-	-	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define capillarity, surface tension, specific weight and specific volume.
2. Differentiate absolute and gauge pressure.
3. Summarize the forces on submerged bodies.

Course Outcome 2 (CO2)

1. With a neat diagram, explain Reynolds experiment.
2. State and explain Newton's law of viscosity. Discuss Newtonian and non-Newtonian Fluids with examples.
3. Explain boundary layer formation and boundary layer separation.

Course Outcome 3(CO3):

1. Derive Bernoulli's equation with all correction factors stating the assumptions.

2. Explain the principle of using flow measurement by orifice meter, rotameter andpitot tube.

3. Derive Ergun equation for pressure drop of flow through packed bed.

Course Outcome 4 (CO4)

1. Explain various factors affecting choice of size reduction equipments.
2. Write notes on photo sedimentation and ICI sedimentation.
3. Explain the Differential and cumulative method of particle size analysis.

Model Question paper

		Total Pages:
Reg No.:_______________		Name:__________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
Course Code: BTT 205		
Course Name: FLUID FLOW AND PARTICLE TECHNOLOGY		
Max. Marks: 100		Duration: 3 Hours
PART A		

		Answer all questions, each carries 3 marks.
1	a)	State Newton’s law of viscosity.
	b)	What is the significance of priming?
	c)	Write any three applications of Hagen-Poiseuille equation.
	d)	What are the necessary conditions to be satisfied for a good streamlining?
	e)	Which are the equations used to calculate the pressure drop through a packed bed?
	f)	Define capillarity, viscosity and compressibility.
	g)	Distinguish real fluid and ideal fluid.
	h)	Explain with necessary equations as to how you would find out the surface tension of a soap bubble and a liquid droplet.
	i)	Differentiate absolute and gauge pressure.

	j)	Outline the term momentum flux and velocity distribution in pipe flow.	

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Explain the conditions for stability of floating and submerged bodies.	(10)
	b)	What is meant by hydrostatic equilibrium? Write down the hydrostatic equation and explain its significance.	(4)
		OR	
3	a)	The surface tension of water in contact with air at 20^0c is 0.0725N/m. The pressure inside the droplet of water is to be 0.02N/cm^2 than the outside pressure. Calculate the diameter of droplet of water	(6)
	b)	A simple U-tube manometer is installed across an orifice meter. The manometer is filled with mercury having specific gravity of 13.6 and the liquid above the mercury has specific gravity1.6. Manometer reading is 200 mm. Calculate the pressure difference in N/m^2	(8)
4	a)	Discuss Bernoulli's equation, clearly stating the assumptions made.	(10)
	b)	Explain the principle behind the operation of a Pitot tube. How is it different from other flow measuring devices?	(4)
		OR	
5	a)	Distinguish between orifice meter and venturi meter. (10 marks)	(10)
	b)	Write a note on cavitation and NPSH.	(4)
6		Derive the shear stress and velocity distribution for laminar flow of fluid through a circular channel. And also drive the relationship between local and maximum velocity.	(14)
		OR	
7		Derive Ergun equation for pressure drop of flow through packed bed.	(9)
8		Explain the principle of using flow measurement by orifice meter, rotameter and pitot tube.	(14)
		OR	
9	a)	Explain various factors affecting choice of size reduction equipment.	(10)
	b)	Write notes on photo sedimentation and ICI sedimentation	(4)
10	a)	Explain the Differential and cumulative method of particle size analysis.	(10)

	b)	Explain drag coefficient and Stokes law.	(4)
		OR	
11		Explain: i) Air classification, ii) Screen capacity and screen efficiency and iii) Any two types of storage methods used industrially	(14)
****			

Syllabus

Properties and nature of fluids, fluid flow characteristics, flow through pipe, transportation and metering of fluids, flow past immersed bodies, Particle technology, describing the size of a single and populations of particles, particle size analysis, particle size reduction, solid-solid and solid-liquid separations, storage and transport of solids.

Module 1: Introduction to fluid

Definition of Fluid, continuum concept of fluid; properties and nature of fluids - Density, Specific weight, Specific Volume, Capillarity and Surface Tension, Viscosity, Vapour pressure, Absolute and Gauge Pressures. (Numerical problems)

Fluid Statics - Forces on fluids and hydrostatic equilibrium, Measurement of Pressure using different types of manometers. Forces on submerged bodies - Buoyancy, Stability of floating and submerged bodies. (Numerical problems)

Introduction to fluid flow- Ideal fluid, Flow of incompressible fluids, flow visualization using the concept of streamline.Classification of flow - Steady and unsteady state flow, uniform and non-uniform flow, rotational and irrotational flow, velocity potential and stream function.

Module 2: Flow Characteristics

Laminar and Turbulent flow - Reynold’s Experiment, Equations of Change for isothermal systems - Equation of Continuity, Qualitative treatment of Equation of Motion – Navier-Stoke’s Equation and Euler equation (derivations not required). Rheology of fluids, Newtonian and non- Newtonian fluids.

Momentum flux and Newton’s Law of Viscosity. Flow in boundary layers: concept of types of drag, boundary layer development in external and internal flow (mathematical analysis is not desired), Overview of boundary layer separation and wake formation.

Flow through pipe - Bernoulli Equation (derivation required), Correction factors in Bernoulli Equation, Pump work – Numerical problems. Outline of pressure losses (Numerical problems not desired) in straight pipes and in fittings. Schedule number of pipes, concept of equivalent diameter.

Module 3: Internal incompressible viscous flow

Introduction; flow of incompressible fluid in circular pipe; laminar flow for Newtonian fluid; Hagen-Poiseullie equation (Derivation required); Shear stress and Velocity distribution in circular channel, energy consideration in pipe flow, relation between average and maximum velocity.

Introduction to turbulent flow in a pipe-Prandtl mixing length; Universal velocity distribution, head loss; friction factor-Fanning and Darcy, Moody diagram.
Transportation and Metering of Fluids - Pumps- Reciprocating and Centrifugal pumps, Characteristics of centrifugal pumps - Priming, cavitation, NPSH, water hammer, loss of head and power in centrifugal pumps.

Flow measurement - Introduction; general equation for internal flow meters; Orifice meter; Venturimeter; Weirs, concept of area meters: rotameter; Local velocity measurement: Pitot tube. Hot wire anemometer, mass flow meter.

Module 4: Resistance of immersed bodies
Introduction; concept of drag and drag coefficient; variation of drag coefficient with Reynolds number. Motion from gravitational and Centrifugal fields - Terminal Settling velocity (Derivation of the equation using force balance is required), Stoke's law-Intermediate law - Newton's law – Hindered Settling. Flow through packed bed; Introduction, Derivation of Kozney Carman equation, Blake Plummer equation and Ergun equation, Applications of packed beds.
Fluidization: Introduction; different types of fluidization; minimum fluidization velocity; governing equation.

Module 5: Particle Technology

Particle technology – Describing the size of a single particle-Shape factor, mean diameter, Particle size analysis-methods of particle size measurement-Sieving, common methods of displaying size distribution. Description of populations of particles, electrozone sensing, laser diffraction, ICI sedimentation, Photosedimentation, Elutriation.

Particle size reduction – Introduction of comminution theory and associated laws, Mechanics of fracture, comminution mechanism, particle size distribution, types of size reduction equipment, factors affecting choice of equipment. Particle size enlargement – flocculation & granulation.

Text Books

1. McCabe, W.L., J.C. Smith and P.Harriot Unit Operations of Chemical Engineering, 6th Edition, Mc Graw Hill, 2001.
2. Coulson J. M and J. F Richardson, *Chemical Engineering: Particle technology and Separation processes (Vol - II),* 5/e, Butterworth-Heinemann, 1999.

Reference Books

1. Geankoplis, C.J. Transport Processes and Separation Process Principles, 5th Edition, Pearson, 2015.
2. Younus A. Cengel and John M. Cimbala, Fluid Mechanics: Fundamentals and Applications, Third Edition, Mc Graw Hill Education.
3. Enrique Ortega-Revas, Unit Operations of Particulate Solids: Theory and Practice, CRC Press.
4. Martin J. Rhodes, Introduction to Particle Technology, 2/e, John Wiley & Sons, 2008.
5. Coulson J. M and J. F Richardson, Chemical Engineering: Fluid flow, Heat transfer and Mass transfer (Vol - I), 5/e, Butterworth-Heinemann, 1999.
6. Perry R. H. and D.W. Green, Eds., Perry's Chemical Engineer's Handbook, 7/e, McGraw Hill, 1997.
7. Narayanan C.M. & Bhattacharya B.C. Mechanical Operations For Chemical Engineers: Incorporating Computer Aided Analysis, Khanna Publishers.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Fluid**	
1.1	Definition of Fluid, continuum concept of fluid; properties and nature of fluids - Density, Specific weight, Specific Volume, Capillarity and Surface Tension, Viscosity, Vapour pressure, Absolute and Gauge Pressures. (Numerical problems)	3
1.2	Fluid Statics - Forces on fluids and hydrostatic equilibrium, Measurement of Pressure using different types of manometers. Forces on submerged	3

	bodies - Buoyancy, Stability of floating and submerged bodies. (Numerical problems)	
1.3	Introduction to fluid flow- Ideal fluid, Flow of incompressible fluids, flow visualization using the concept of streamline. Classification of flow - Steady and unsteady state flow, uniform and non-uniform flow, rotational and irrotational flow, velocity potential and stream function.	4
2	**Flow Characteristics**	
2.1	Laminar and Turbulent flow - Reynold's Experiment, Equations of Change for isothermal systems - Equation of Continuity, Qualitative treatment of Equation of Motion – Navier-Stoke's Equation and Euler equation (derivations not required). Rheology of fluids, Newtonian and non-Newtonian fluids.	3
2.2	Momentum flux and Newton's Law of Viscosity, Flow in boundary layers: concept of types of drag, boundary layer development in external and internal flow (mathematical analysis is not desired) - Overview of boundary layer separation and wake formation	3
2.3	Flow through pipe - Bernoulli Equation (derivation required), Correction factors in Bernoulli Equation, Pump work – Numerical problems. Outline of pressure losses (Numerical problems not desired) in straight pipes and in fittings,Schedule number of pipes, concept of equivalent diameter.	4
3	**Internal Incompressible viscous flow**	
3.1	Introduction; flow of incompressible fluid in circular pipe; laminar flow for Newtonian fluid; Hagen-Poiseullie equation (Derivation required); Shear stress and Velocity distribution in circular channel,energy consideration in pipe flow, relation between average and maximum velocity.	3
3.2	Introduction to turbulent flow in a pipe-Prandtl mixing length; Universal velocity distribution,head loss; friction factor-Fanning and Darcy, Moody diagram. Transportation and Metering of Fluids - Pumps- Reciprocating and Centrifugal pumps, Characteristics of centrifugal pumps - Priming, cavitation, NPSH, water hammer, loss of head and power in centrifugal pumps.	5
3.3	Flow measurement - Introduction; general equation for internal flow meters; Orifice meter; Venturimeter; Weirs, concept of area meters: rotameter; Local velocity measurement: Pitot tube. Hot wire anemometer, mass flow meter.	2
4	**Resistance of Immersed bodies**	

4.1	Introduction; concept of drag and drag coefficient; variation of drag coefficient with Reynolds number.	2
4.2	Motion from gravitational and Centrifugal fields - Terminal Settling velocity (Derivation of the equation using force balance is required), Stoke's law- Intermediate law - Newton's law – Hindered Settling.	3
4.3	Flow through packed bed; Introduction, Derivation of Kozney Carman equation, Blake Plummer equation and Ergun equation, Applications of packed beds. **Fluidization:** Introduction; different types of fluidization; minimum fluidization velocity; governing equation.	3
5	**Particle Technology**	
5.1	Particle technology – Describing the size of a single particle-Shape factor, mean diameter, Particle size analysis-methods of particle size measurement-Sieving, common methods of displaying size distribution. Description of populations of particles, electrozone sensing, laser diffraction, ICI sedimentation, Photosedimentation, Elutriation.	4
5.2	Particle size reduction – Introduction of comminution theory and associated laws, Mechanics of fracture, comminution mechanism, particle size distribution, types of size reduction equipment, factors affecting choice of equipment. Particle size enlargement – flocculation & granulation	3

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
BTL201	MICROBIOLOGY LAB	PCC	0	0	3	2

Preamble: Handle microorganisms and also to identify and characterise microorganisms

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate proper usage, identify the parts/functions of a bright field microscope and visually recognize the microscopic characteristics of bacteria
CO 2	Apply appropriate laboratory techniques and methodology for isolation, characterization, propagation and enumeration of microorganisms in a given sample
CO 3	Demonstrate an understanding and appreciation of the impact of microorganisms on agriculture, environment, ecosystem, energy, and human health
CO 4	Apply appropriate microbiology laboratory techniques, methodologies, instruments and equipment in accordance with current laboratory safety protocol

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	2	2	-	1	1	-	3	2	-	-
CO 2	-	-	2	2	-	2	2	-	3	2	-	-
CO 3	-	-	2	2	-	3	3	-	3	2	-	-
CO 4	-	-	-	-	-	1	1	-	3	2	-	-

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting) : 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering the entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State the functionality of a Bright field microscope with reference to examination of microscopic characteristics.

2. List the steps involved in preparation of PDA media.

3. Demonstrate the preparation of EMB agar

Course Outcome 2 (CO2)

1. Enumerate the microbial cells through a Haemocytometer

2. Detail the procedure for isolation and characterize bacteria from leaf tissues

3. Demonstrate the isolation of bacteria from water

Course Outcome 3(CO3):

1. Demonstrate IMViC reactions. Signify the method giving reasons

2. Detail the principle and procedure for microbiological examination of water

3. Perform the methodology for long term storage of microorganisms

Course Outcome 4 (CO4):

1. Demonstrate the method for testing microbial capacity to produce biologically active substance

2. Monitor cell growth through wet weight and record the observations to evaluate the growth

3. List out the steps involved in obtaining a plant protoplast

Syllabus

1. Introduction to principles of sterilization techniques.
2. Principles of microscopy, phase contrast and fluorescent microscopy
3. Preparation of media and media components.
4. Media preparation: General purpose; differential and selective media
5. Selection and isolation of bacteria from natural sources
6. Staining: Gram, Giemsa , Trypan blue, endospore
7. Haemocytometer
8. Measurement of growth - Wet weight and dry weight measurements, extinction method of monitoring cell growth.
9. Isolation and characterization of bacteria from leaf tissues, leaf rot etc.
10. Taxonomic classification of isolated microbes
11. Long and short term storage of microbes (bacteria and fungi)

12. Testing of microbial capacity to produce biologically active substances
13. Isolation of fungal and plant protoplasts
14. Microbiological examination of water.
15. Biochemical tests: IMVIC test, Catalase test, Gelatinase test, Oxidase test and other related tests.

Any 12 experiments are compulsory

Text Books

1.Alfred Brown, *Benson's Microbiological Applications: Laboratory Manual in General Microbiology,* McGraw Hill Publications, 2004.
2.Gunasekharan P, *Laboratory manual in Microbiology*, New Age International Publishers, 2007.

Reference Books

1. Cappuccino J. G. and N. Sherman, A*Laboratory Manual*, 4/e, Addison and Wesley, 1999.

2. Molecular Microbiology: Diagnostic Principles and Practice by Persing DH, Tenover FC, Versalovic J, Tang Y, Unger ER, Relman DA, White TJ eds. American Society for Microbiology Press, 2004.

6. Infectious Disease Epidemiology: Theory and Practice by Nelson KE, Williams CM, Graham NMH eds. An Aspen Publication. 2001.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Introduction to principles of sterilization techniques.	3
2	Principles of microscopy, phase contrast and fluorescent microscopy	3
3	Preparation of media and media components.	3
4	Media preparation: General purpose; differential and selective media	3
5	Selection and isolation of bacteria from natural sources	3
6	Staining: Gram, Giemsa , Trypan blue, endospore	3
7	Haemocytometer	3
8	Measurement of growth - Wet weight and dry weight measurements, extinction method of monitoring cell growth.	3
9	Isolation and characterization of bacteria from leaf tissues, leaf rot etc.	3
10	Taxonomic classification of isolated microbes	3

11	Long and short term storage of microbes (bacteria and fungi)	3
12	Testing of microbial capacity to produce biologically active substances	3
13	Isolation of fungal and plant protoplasts	3
14	Microbiological examination of water.	3
15	Biochemical tests:IMVIC test, Catalase test, Gelatinase test, Oxidase test and other related tests.	3

BTL203	FLUID FLOW AND PARTICLE TECHNOLOGY LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: Enhance practical skills with momentum transfer mechanisms in industrial bio processing.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Determine fluid properties, particle size, characterize flows, measure pressure, calibrate flow measuring equipment, and analyze frictional flows by performing experiments in the laboratory.
CO 2	Design experiments and analyze/interpret data collected from experimental investigation in fluid statics and kinematics.
CO 3	Use modern computing tools necessary for analysis of the experimental data in fluid statics and kinematics
CO 4	Exhibit ethical principles in the engineering profession by practicing ethical approaches in experimental investigation, collection and reporting of data and adhering to the relevant safety practices in the laboratory.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	2	-	-	2	2	2	-	-
CO2	3	3	-	3	-	-	-	-	-	-	-	-
CO3	3	3	-	3	2	-	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	2	-	-	-	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration

150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting) : 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1.Study of measurement of pressure
2. Use of viscometers for measurement of viscosity of process fluids.
3. Study on factors influencing viscosity of process fluids

Course Outcome 2 (CO2)

1.Reynold’s Experiment

2.Determination of venturi coefficient/ orifice coefficient.
3.Calibration of Rotameter for liquid flows.

Course Outcome 3(CO3):

1.Determination of velocity profile using Pitot tube.
2.Determination of energy losses in pipes and fittings
3.Estimation of pressure drop for flow through packed bed.

Course Outcome 4 (CO4):

1.Estimation of pressure drop for flow through fluidized bed.
2.Determination of drag coefficient and verification of Stoke's law.
3.Particle size analysis by Sieve analysis.

Model Question paper (Total marks-30)

Syllabus

1. Study of measurement of pressure
2. Use of viscometers for measurement of viscosity of process fluids.
3. Study on factors influencing viscosity of process fluids
4. Reynold's Experiment
5. Determination of venturi coefficient/ orifice coefficient.
6. Calibration of Rotameter for liquid flows.
7. Determination of velocity profile using Pitot tube.
8. Determination of energy losses in pipes and fittings
9. Estimation of pressure drop for flow through packed bed.
10. Estimation of pressure drop for flow through fluidized bed.
11. Determination of drag coefficient and verification of Stoke's law.
12. Particle size analysis by Sieve analysis.
13. Sub sieve particle size analysis using Beaker decantation.
14. Sub sieve particle size analysis using Pipette Analysis.
15. Studies on flocculation- Analysis of orthokinetic and perikinetic aggregation.

Text Books

1. McCabe W. L., J. C. Smith and P. Harriott, *Unit Operations of Chemical Engineering*, 6/e, McGraw Hill, 2000.
2. Coulson J. M and J. F Richardson, *Chemical Engineering: Particle technology and Separation processes (Vol - II),* 5/e, Butterworth-Heinemann, 1999.

Reference Books

1. Martin J. Rhodes, *Introduction to Particle Technology*, 2/e, John Wiley & Sons, 2008.

2. Coulson J. M and J. F Richardson, *Chemical Engineering: Fluid flow, Heat transfer and Mass transfer (Vol - I)*, 5/e, Butterworth-Heinemann, 1999.

3. Perry R. H. and D.W. Green, Eds., *Perry's Chemical Engineer's Handbook*, 7/e, McGraw Hill, 1997.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Study of measurement of pressure	3
2	Use of viscometers for measurement of viscosity of process fluids.	3
3	Study on factors influencing viscosity of process fluids	3
4	Reynold's Experiment	3
5	Determination of venturi coefficient/ orifice coefficient.	3
6	Calibration of Rotameter for liquid flows.	3
7	Determination of velocity profile using Pitot tube.	3
8	Determination of energy losses in pipes and fittings	3
9	Estimation of pressure drop for flow through packed bed.	3
10	Estimation of pressure drop for flow through fluidized bed.	3
11	Determination of drag coefficient and verification of Stoke's law.	3
12	Particle size analysis by Sieve analysis.	3
13	Sub sieve particle size analysis using Beaker decantation.	3
14	Sub sieve particle size analysis using Pipette Analysis.	3
15	Studies on flocculation- Analysis of orthokinetic and perikinetic aggregation.	3

SEMESTER -3

MINOR

BTT281	UPSTREAM PROCESSING	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Methods to understand, identify the appropriate microorganism and its scale up process for a specific industrial purpose

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basics of isolation, screening and maintenance of industrially important microbes, preservation techniques and various culture collection centers available
CO 2	Practice the concepts in Media formulation and the effect of environmental conditions for cell growth and product synthesis
CO 3	Analyze the performance of sterilization of medium, sterilization methods**,** design of batch and continuous sterilization processes
CO 4	Development and implementation techniques for inoculums transfer and its applications
CO 5	Define and understand the different modes of fermentation process, fermenter design and monitoring of process variables

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	3	-	-	-	3	-	-	3	-	3
CO 2	-	-	3	-	-	-	3	2	-	3	-	3
CO 3	-	-	3	-	-	-	-	-	-	3	-	3
CO 4	-	-	-	-	-	-	-	-	-	3	-	3
CO 5	2	-	3	-	-	-	-	2	-	3	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10

Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the basics of isolation, screening and maintenance of industrially important microbes, preservation techniques and various culture collection centers available

1. Illustrate Protoplast fusion method for strain improvement.

2. Brief about the steps involved in the isolation of a pure culture.

3. Outline the objectives and need for Culture collection and Biological resource centres. Give examples

Course Outcome 2 (CO2) : Practice the concepts in Media formulation and the effect of environmental conditions for cell growth and product synthesis

1 List out the different nitrogen sources used in industrial scale fermentation process

2. Discuss the effect of environmental conditions on growth of microorganisms.

3. Write note on the characteristics of a fermentation media.

Course Outcome 3(CO3): Analyze the performance of sterilization of medium, sterilization methods**,** design of batch and continuous sterilization processes

1 Brief about the methods of sterilisation.

2. What are the factors to be considered during the insitu sterilisation of a fermenter?

3. Describe the design aspects of batch sterilisation

Course Outcome 4 (CO4): Development and implementation techniques for inoculum transfer and its applications

1. Discuss about the development of inocula for animal cell processes.

2. Explain the criteria for choosing an inoculum.

3. Outline the inoculum preparation for mycelia process.

Course Outcome 5 (CO5): Define and understand the different modes of fermentation process, fermenter design and monitoring of process variables

1. Compare solid state and submerged fermentation process

2. Explain the process of monitoring pH in a fermenter

3. Write a note on different types of impeller designs.

Model Question paper

		Total Pages:
Reg No.:_______________		Name:__________________________ _
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION _________ _____ 20__		
Course Code: BTT 281		
Course Name: UPSTREAM PROCESSING		
Max. Marks: 100		Duration: 3 Hours
PART A		

		Answer all questions, each carries 3 marks.
1	a)	Write a note on culture collection and biological centres
	b)	Discuss about the steps in preparing pure culture
	c)	Mention about the raw materials and medium requirements for industrial

		fermentation	
	d)	Explain the importance of anti foaming agents in medium formulation. Give two examples of anti foaming agents	
	e)	Sketch the diagram of batch sterilization and it's time profile	
	f)	Explain the significance of DEL factor	
	g)	Explain the various steps involved in the development of inoculums	
	h)	What are the characteristics of a good inoculums?	
	i)	What are the advantages of solid state fermentation over submerged sterilization	
	j)	List out the modes of fermentation process	
		PART B	
		Answer any one full question from each module. Each carries 14 marks.	
2		Explain the need for strain improvement. Brief about the strain improvement by protoplast fusion and r- DNA technology.	(14)
		OR	
3		Describe the different screening methods for the isolation of microorganisms	(14)
4		Discuss the role of each nutrient in fermentation media. Give examples	(14)
		OR	
5		Explain the effect of various environmental factors on growth and product formation	(14)
6		With a neat diagram explain the different types of continuous sterilizers.	(14)
		OR	
7		Explain the design of batch sterilizer. Write note on scale up of fermenter	(14)
8		Explain about the development of inoculums for yeast processes with neat sketches.	(14)
		OR	
9		Explain with an example development of inocula for bacterial process	(14)
10		Describe the monitoring and control of temperature and foam formation in a fermenter	(14)

		OR	
11		Briefly explain the different types of fermentation processes	(14)
****			

Syllabus

Module 1

Isolation and strain development: Isolation, screening and maintenance of industrially important microbes. Strain improvement techniques to improve the yield- recombinant DNA technology, protoplast fusion, and mutation, preparation of pure culture at lab scale, preservation techniques, culture collection and biological resource centers.

Module 2

Media formulation: Nutritional requirement-energy source, carbon source, nitrogen source,oxygen requirement, micro nutrients, growth factors, buffers, antifoams, Formulation of media for fermentation, effect of environmental conditions for cell growth and product synthesis, optimization of growth parameters at lab scale.

Module 3

Sterilization: Sterilization of medium- Sterilization methods**,** Design of batch and continuous sterilization processes, methods for batch sterilization, scale up of batch sterilization, Sterilization of- fermenter, feed, liquid waste and filter

Module 4

Inoculum development: Criteria for the transfer of inoculum, Development of inocula for animal cell processes, Development of inocula for yeast processes, Development of inocula for unicellular bacterial processes, Development of inocula for mycelial processes, Aseptic inoculation of plant fermenters.

Module 5

Fermentation and scale up: Different modes of fermentation process- batch, continuous, fed batch, Different types of fermentation process- solid state and submerged fermentation. Fermenter design- body construction, aeration and agitation, maintenance of aseptic conditions, monitoring of process variables- temperature, pressure, pH, foaming, dissolved oxygen content.

Text Books

1. Peter F. Stanbury Allan Whitaker Stephen Hall, *Principles of Fermentation Technology*,2nd Edition, Butterworth-Heinemann 1995

2. Pauline M. Doran Bioprocess Engineering Principles Academic press - 2nd Edition 2012

3. WulfCruger and AnnelieseCrueger, Biotechnology: *A Textbook of Industrial Microbiology*, 2nd Edition, Panima Publishing Corporation, 2004.

Reference Books

1. Michael C Flickinge (Ed.), *Upstream Industrial Biotechnology*, Volumes 1 & 2, Wiley 2013
2. Brian McNeil, Linda Harvey (Eds.), *Practical Fermentation Technology*, Wiley, 2008.
3. J E Bailey, D F Ollis, *Biochemical Engineering Fundamentals*, 2/e, McGraw-Hill Chemical Engineering Series, 1986.
4. Michael L Shuler, FikretKargi, *Bioprocess Engineering Basic Concepts*, Prentice Hall, 1992.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**ISOLATION AND STRAIN IMPROVEMENT**	
1.1	Isolation, screening and maintenance of industrially important microbes.	3
1.2	Strain improvement techniques to improve the yield-recombinant DNA technology, protoplast fusion, and mutation	2
1.3	Preparation of pure culture at lab scale	1
1.4	Preservation techniques,	1
1.5	Culture collection and biological resource centers.	1
2	**MEDIA FORMULATION**	
2.1	Nutritional requirement-energy source, carbon source, nitrogen source, oxygen requirement, micro nutrients, growth factors, buffers, antifoams,	3
2.2	Formulation of media for fermentation	2
2.3	Effect of environmental conditions for cell growth and product synthesis	2
2.4	Optimization of growth parameters at lab scale.	2
3	**STERILIZATION**	
3.1	Sterilization of medium- Sterilization methods	1
3.2	Design of batch and continuous sterilization processes,	3

3.3	Methods for batch sterilization	2
3.4	Scale up of batch sterilization	2
3.5	Sterilization of- fermenter, feed, liquid waste and filter	2
4	**INOCULUM DEVELOPMENT**	
4.1	Criteria for the transfer of inoculums, Development of inocula for animal cell processes	2
4.2	Development of inocula for yeast processes	2
4.3	Development of inocula for unicellular bacterial processes	2
4.4	Development of inocula for mycelial processes	2
4.5	Aseptic inoculation of plant fermenters.	2
5	**FERMENTATION AND SCALE UP**	
5.1	Different modes of fermentation process- batch, continuous, fed batch	2
5.2	Different types of fermentation process- solid state and submerged fermentation	2
5.3	Fermenter design- body construction, aeration and agitation	2
5.4	Maintenance of aseptic conditions, monitoring of process variables- temperature, pressure, pH, foaming, dissolved oxygen content.	2

BTT283	CELL BIOLOGY AND BIOMOLECULES	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Have a clear knowhow of the biomolecules in maintaining life and health

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Outline the basics fundamental aspects of life
CO 2	Interpret the biomolecules and their function
CO 3	Understanding vitamins, enzymes and their function
CO 4	Fundamentals of *in vitro* culture and applications

Mapping of course outcomes with program outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	-	-	-	2	-	-	-	2	-	2
CO 2	3	3	2	-	-	2	-	-	-	2	-	2
CO 3	3	3	3	2	-	-	-	-	-	2	-	-
CO 4	-	-	3	3	-	-	-	-	-	2	2	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State the Cell theory.

2. Explain about the extracellular matrix.

3. Define the functions of mitochondria.

Course Outcome 2 (CO2)

1. Classify carbohydrates and explain their role in maintenance of cellular integrity.

2. Give a detailed note on cell cycle.

3. Demonstrate the significance of cholesterol.

Course Outcome 3(CO3):

1. Exemplify the nomenclature of enzymes

2. Give a detailed note on fat soluble vitamins.

3. Describe the basic functions of enzymes.

Course Outcome 4 (CO4):

1. Demonstrate the laboratory requirements for animal cell culture.

2. Give examples of various culture media used in animal cell culture

3. Describe the significance of stem cells

Model Question paper

			Total Pages:
Reg No.:______________		Name:________________________ _	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 283

Course Name: CELL BIOLOGY AND BIOMOLECULES

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1	a)	Enumerate on the various transport systems present on the cell membranes.
	b)	Exemplify the role of extracellular matrix in the maintenance of structural integrity of a cell.
	c)	Enumerate the checkpointsin the cell cycle.
	d)	Recall Cell theory.
	e)	Describe the formation of peptide bonds.
	f)	List any three roles of vitamins in our body.
	g)	Elaborate the process of hydrolysis of fats.
	h)	Describe the significance of serum in animal cell culture
	i)	Describe base pairing rule.
	j)	Give the significance of mucopolysaccharides.

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Elaborate on the structural levels of organization of proteins with suitable diagrams.	(14)
		OR	

3		Give a detailed note on classification and nomenclature of enzymes	(14)
4		Enumerate the types of culture media used in animal cell culture.	(14)
		OR	
5		Elaborate on the double helical model of DNA.	(14)
6		Enumerate the structure and properties of phospholipids and glycolipids	(14)
		OR	
7		Elaborate on the general structure and properties of monosaccharides	(14)
8		Elaborate the different stages of mitosis with suitable diagrams.	(14)
		OR	
9		Describe what stem cells are and give its biological importance.	(14)
10		Explain about passive and active transport system with suitable examples.	(14)
		OR	
11		Enumerate endocytosis and exocytosis with suitable examples.	(14)
		****	

Syllabus

Module 1

Cell and cellular organelles

Discovery of cells.Basic properties of cells.Cell theory.Prokaryotic & Eukaryotic cells.Plasma membrane – structure and function.Passive and active transport across membranes.Endocytosis and Exocytosis.Functions of Nucleus, Endoplasmic reticulum, Golgi complex, Lysosomes, Peroxisomes, Chloroplast & Mitochondria.

Module 2

Cell cycle and Extracellular matrix

Overview of the cell cycle, Different stages of mitosis – significance of meiosis and cytokinesis. Fertilization.Components in cell cycle control - Cyclin, CDKs, Check points in cell cycle.General characteristics of cell differentiation.The extracellular matrix-collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans.(Functions Only). Stem cells and its biological importance.

Module 3

Carbohydrates and Lipids

Importance of carbon and water.Introduction to biochemistry.A historical perspective. General features of biomolecules. General structure and properties of monosaccharides, oligosaccharides and polysaccharides. Significance of Homo heteropolysaccharides and Mucopolysaccharides . Blood group substances.
Lipids - classification and structure, essential fatty acids- glycerides, hydrolysis of fats, structure and properties of phospholipids and glycolipids. Significance of Cholesterol and Prostaglandins (Structure NOT needed) .

Module 4

Proteins and Vitamins

Nomenclature and properties of amino acids.General reactions of amino acids.Peptide bond.Classification of proteins, Basic understanding of primary, secondary, tertiary and quaternary structure of proteins.Denaturation and renaturation. Enzymes: Nomenclature and classification of enzymes.
Vitamins (only significance) : Fat soluble (A , D, E & K) and Water Soluble (B and C)

Module 5

Nucleic acids and Cell culture basics

Nucleic acids: structure and properties of Purine and pyrimidine bases. Nucleosides and nucleotides.Base pairing role.Structure and functions of DNA and RNA Double helical model of DNA structure.
Animal cell culture. Physical requirements for growing animal cell culture. Culture media for animal cell culture

Text Books

1. Gerald Karp ,Cell Biology
2. Fundamentals of Biochemistry by Jain & Jain
3. Textbook of Biochemistry by Vasudevan&Sreekumari
4. M.M Ranga, Animal Biotechnology, second Edition, Agrobios India

Reference Books

1. Essentials of Cell Biology by Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander D.Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter
2. Lehninger's Principles of Biochemistry

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Cell and cellular organelles**	
1.1	Discovery of cells. Basic properties of cells. Cell theory. Prokaryotic & Eukaryotic cells. Plasma membrane – structure and function.	2
1.2	Passive and active transport across membranes. Endocytosis and Exocytosis.	3
1.3	Functions of Nucleus, Endoplasmic reticulum, Golgi complex	2
1.4	Functions of lysosomes, Peroxisomes, Chloroplast & Mitochondria	2
2	**Cell cycle and Extracellular matrix**	
2.1	Overview of the cell cycle, Different stages of mitosis – significance of meiosis and cytokinesis. Fertilization.	2
2.2	Components in cell cycle control - Cyclin, CDKs, Checkpoints in cell cycle. General characteristics of cell differentiation.	2
2.3	The extracellular matrix-collagen, elastin, fibrillin, fibronectin, laminin and proteoglycans. (Functions Only).	2
2.4	Stem cells and its biological importance.	2
3	**Carbohydrates and Lipids**	
3.1	Importance of carbon and water. Introduction to biochemistry. A historical perspective. General features of biomolecules.	1
3.2	General structure and properties of monosaccharides, oligosaccharides and polysaccharides. Significance of Homo heteropolysaccharides and Mucopolysaccharides . Blood group substances.	5
3.3	Lipids - classification and structure, essential fatty acids- glycerides, hydrolysis of fats	2
3.4	Structure and properties of phospholipids and glycolipids.	2
3.5	Significance of Cholesterol and Prostaglandins (Structure NOT needed).	1
4	**Proteins and Vitamins**	
4.1	Nomenclature and properties of amino acids. General reactions of amino acids. Peptide bond. Classification of proteins,	2
4.2	Basic understanding of primary, secondary, tertiary and quaternary structure of proteins. Denaturation and renaturation.	2
4.3	Enzymes: Nomenclature and classification of enzymes.	2

4.4	Vitamins (only significance) : Fat soluble (A , D, E & K) and Water Soluble (B and C)	2
5	**Nucleic acids and cell culture basics**	
5.1	Nucleic acids: structure and properties of Purine and pyrimidine bases.	2
5.2	Nucleosides and nucleotides. Base pairing role.	2
5.3	Structure and functions of DNA and RNA Double helical model of DNA structure.	2
5.4	Animal cell culture. Physical requirements for growing animal cell culture. Culture media for animal cell culture	3

BTT285	HEALTH, SAFETY AND ENVIRONMENT	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Acquire basic knowledge and relevant information regarding environment for human health and safety

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the principles and practices in environmental protection
CO 2	Outline the key aspects of environmental impact assessment and economic analysis.
CO 3	Outline the rules and legislations for environment protection and social security.
CO 4	Explain the key attributes of energy efficient infrastructure.
CO 5	Highlight the major concerns in global climate change and its impact on the environment.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	3	3	-	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	2	3	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1): Principles and practices in environmental protection**

1. Explain the relationship between society and environment.
2. Illustrate the ecosystem and factors causing the imbalance.
3. Demonstrate the principles and practices in prevention and control of pollution.

- **Course Outcome 2 (CO2) :Environmental Impact Assessment**

1. Summarize the principles, production and assessment of impacts due to air pollution on the environment.
2. Elucidate the potentially applicable techniques of valuing environmental impacts.
3. Mention any two case studies on the limits of economical measurement of environmental impacts.

- **Course Outcome 3(CO3):Social Security Legislation, Miscellaneous acts and rules**
    1. Explain on the safety, health and welfare under legislative of India.
    2. Summarize on social security legislation.
    3. Specify on the prevention and control of pollution act 1981 and 1982, Environment protection act 1986.

- **Course Outcome 4 (CO4): Energy efficient infrastructure**

1. Summarize on energy efficient buildings.
2. Mention the energy management in buildings and energy audit of buildings.
3. Specify the energy conservation, reduce and recycle.

- **Course Outcome 5 (CO5): Major concerns in climate change and impacts**

1. Summarize on global climate changes.
2. Elucidate the Earth's carbon reservoirs.
3. Explain the global ocean circulation.

Model Question paper

			Total Pages:
Reg No.:______________			Name:_________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 285

Course Name: HEALTH, SAFETY AND ENVIRONMENT

Max. Marks: 100	Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Define the relation between society and environment.
	b)	Specify the factors causing the imbalance in the ecosystem.
	c)	Point out the pollutants including liquid, gaseous, solid and hazardous waste.
	d)	Explain the Environmental Impact Assessment.
	e)	List out any five potentially applicable techniques of valuing environmental impacts.
	f)	Explain the workmen's compensation act.
	g)	Specify Environment Protection Act 1986.
	h)	Define Earth's natural greenhouse effect.
	i)	Explain the global ocean circulation.
	j)	Specify the examples of Earth's carbon reservoirs.

PART B			
Answer any one full question from each module. Each carries 14 marks.			
2		Summarize on principles and practices in prevention and control of pollution.	(14)
		OR	
3		Summarize on hazardous waste management.	(14)
4		Explain the principles, production and assessment of impacts due to air and water pollution on the environment.	(14)
		OR	
5	a)	Explain the economic measurement of environmental impacts.	(8)
	b)	Elucidate a case study on the economic measurement of environmental impacts.	(6)
6		Summarize on the safety, health and welfare under legislative of India	(14)
		OR	
7	a)	Explain on the general provision of gas cylinders rules.	(6)
	b)	Explain the Explosives Act 1884 and rules.	(8)
8		Elucidate the energy conservation, reuse and recycle with examples.	(14)
		OR	
9		Summarize on energy efficient buildings	(14)
10		Explain the global climate changes.	(14)
		OR	
11		Demonstrate the Earth's carbon reservoirs.	(14)

****

Syllabus

Module 1: Ecosystem, Pollution and Environment Protection

ECOSYSTEM: Introduction to environment. Relationship between society and environment, ecosystem and factors causing imbalance.

POLLUTION: Pollution and pollutants including liquid, gaseous, solid and hazardous waste.

ENVIRONMENT PROTECTION: Right attitude towards environment, Maintenance of in-house environment.Safety and protection of existing environment, Principles & practices in prevention & control of pollution, water pollution, Introduction to hazardous waste management.

Module 2: Environmental Impact Assessment

ENVIRONMENTAL IMPACT ASSESSMENT: Principles, production and assessment of impacts due to air and water pollution on the environment. Environment impact assessment in the land and biological environment, methodologies for environmental impact assessment – Case studies.

Assessing impacts and setting priorities – Economic measurement of environmental impacts – Theoretical basis and practical applications. Selectively applicable techniques of valuing environmental impacts – Potentially applicable techniques of valuing environmental impacts.Maximum credible accident - Rapid environmental impact assessment - The limits of economic measurement of environmental impacts – Case studies.

Module 3: Legislation and rules

BASIC PROVISIONS: Idea of basic provision legislation of India. Safety, health and welfare under legislation of India.

SOCIAL SECURITY LEGISLATION: Social security legislation, Introduction to workmen's compensation act, contract labour regulation act.

MISCELLANEOUS ACTS & RULES: Explosives act 1884 and rules. General provision of gas cylinders rules, The building and other construction worker's welfare cess act & rules 1996. Environment protection legislation: Introduction to prevention and control of pollution act 1981 and 1982, Environment protection act 1986.

Module 4: Energy Conservation

ENERGY CONSERVATION: Conservation of energy, reuse and recycle.

ENERGY EFFICIENT BUILDINGS: Architecture- Building science and its significance. Indoor environment.Components of indoor environments.Quality of indoor environment.Human comfort-thermal, visual, acoustical and olfactory comfort.Concept of sol-air temperature and its significance.ventilation and its significance. Cooling and heating concepts, passive concepts appropriate for the various climatic zones in India. Classification of building materials based on energy intensity.

Energy Management of buildings and energy audit of buildings - Energy management matrix monitoring and targeting.Energy efficient landscape design -Modification of microclimate through landscape elements for energy conservation.

Module 5: Global Climate Change
GLOBAL CLIMATE CHANGE:

Climate in the spotlight- Earth's natural greenhouse effect -General Overview- radiative balance- Importance of Water

Greenhouse gases :Role of carbon dioxide and methane- Major uncertainties, CO_2 emissions-Human emissions of CO_2 -Different concerns of rich and poor countries.

The Earth's carbon reservoirs –Biogeochemistry, carbon cycling: Some Examples - Physical carbon pump, Biological Carbon Pump- marine carbon cycle, terrestrial Carbon cycle.

Climate and Weather: The Earth's climate machine- Global wind systems. Clouds, storms and climate - Cloud formation and climate, Hurricanes and global warming.

Global ocean circulation -Introduction and overview.

El Niño and the southern oscillation -El Niño and its effects,-upwelling and climate.

Introduction to climate change-Advances in computer modelling -Physics versus fudge factors.

Text Books

1. Barthwal, R. R., Environmental Impact Assessment, New Age International publishers (P) Ltd., 2002
2. C.S. Holling, Adaptive environmental assessment and Management, John Wiley and Sons, 2000
3. S.A. Abbasi and N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India, N. Delhi 2006
4. Sodha M.,Bansal, N.K., Bansal,P.K., Kumar, A. and Malik, M.A.S., Solar Passive Buildings, Pergamon Press, 1986

Reference Books

1. Koenigsberger, O.H., Ingersoll, T.G., Mayhew Alan and Szokolay, S. V., "Manual of Tropical Housing and Building part 1: Climatic Design", OLBN 0 00212 0011,Orient Longman Limited, 1973.
2. Bureau of Indian Standards, I.S. 11907 –1986 Recommendations for calculation of Solar Radiation Buildings, 1986.
3. Givoni,B., "Man, Climate and Architecture", Elsevier, Amsterdam, 1986.
4. Smith, R. J., Phillips, G.M. and Sweeney, M. "Environmental Science", Longman Scientific and Technical, Essex, 1982.
5. Trevor. M. Letcher, Climate Change: Observed impacts on planet Earth, Elsevier, 2016.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Ecosystem, Pollution and Environment Protection (8 hrs)**	
1.1	**ECOSYSTEM**: Introduction to environment. Relationship between society and environment, ecosystem and factors causing imbalance.	3
1.2	**POLLUTION**: Pollution and pollutants including liquid, gaseous, solid and hazardous wastes	2
1.3	**ENVIRONMENT PROTECTION**: Right attitude towards environment, Maintenance of in-house environment.Safety and protection of existing environment, Principles & practices in prevention & control of pollution, water pollution, Introduction to hazardous waste management.	3
2	**Environmental Impact Assessment (10 hrs)**	
2.1	**ENVIRONMENTAL IMPACT ASSESSMENT**: Principles, production and assessment of impacts due to air and water pollution on the environment.	2
2.2	Environment impact assessment in the land and biological environment, methodologies for environmental impact assessment – Case studies	2
2.3	Assessing impacts and setting priorities – Economic measurement of environmental impacts – Theoretical basis and practical applications. Selectively applicable techniques of valuing environmental impacts – Potentially applicable techniques of	4

	valuing environmental impacts.	
2.4	Maximum credible accident - Rapid environmental impact assessment - The limits of economic measurement of environmental impacts – Case studies	2
3	**Legislation and Rules (6 hrs)**	
3.1	**BASIC PROVISIONS**: Idea of basic provision legislation of India. Safety, health and welfare under legislation of India.	2
3.2	**SOCIAL SECURITY LEGISLATION**: Social security legislation, Introduction to workmen's compensation act, contract labour regulation act.	2
3.3	**MISCELLANEOUS ACTS & RULES:** Explosives act 1884 and rules. General provision of gas cylinders rules, The building and other construction worker's welfare cess act & rules 1996. Environment protection legislation: Introduction to prevention and control of pollution act 1981 and 1982, Environment protection act 1986.	2
4	**Energy Conservation (10 Hrs)**	
4.1	**ENERGY CONSERVATION**: Conservation of energy, reuse and recycle.	3
4.2	**ENERGY EFFICIENT BUILDINGS**: Architecture- Building science and its significance. Indoor environment. Components of indoor environments. Quality of indoor environment. Human comfort-thermal, visual, acoustical and olfactory comfort. Concept of sol-air temperature and its significance. ventilation and its significance. Cooling and heating concepts, passive concepts appropriate for the various climatic zones in India. Classification of building materials based on energy intensity.	4
4.3	Energy Management of buildings and energy audit of buildings - Energy management matrix monitoring and targeting. Energy efficient landscape design -Modification of microclimate through landscape elements for energy conservation.	4
5	**Global Climate Change (10 hrs)**	
5.1	Climate in the spotlight- Earth's natural greenhouse effect - General Overview- radiative balance- Importance of Water Greenhouse gases :Role of carbon dioxide and methane- Major uncertainties, CO_2 emissions-Human emissions of CO_2 -Different concerns of rich and poor countries.	4
5.2	The Earth's carbon reservoirs –Biogeochemistry, carbon cycling: Some Examples - Physical carbon pump, Biological Carbon Pump-marine carbon cycle, terrestrial Carbon cycle.	3

	Climate and Weather: The Earth's climate machine- Global wind systems. Clouds, storms and climate - Cloud formation and climate, Hurricanes and global warming.	
5.3	Global ocean circulation -Introduction and overview. El Niño and the southern oscillation -El Niño and its effects,- upwelling and climate. Introduction to climate change-Advances in computer modelling - Physics versus fudge factors.	3

SEMESTER -4

BTT202	CHEMICAL AND BIOLOGICAL REACTION ENGINEERING	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: Study in detail the Chemical basis of Biological reactions

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Estimate the kinetics for chemical and biological reactions
CO 2	Analyze the performance of Batch and Continuous reactors and recommend modifications for improvement
CO 3	Predict the conversion for ideal and non-ideal reactors
CO 4	Explain the nature of catalytic reactions with regard to the multiple steps of mass transfer and surface reaction and the concept of rate limiting step

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	3	-	2	2	1	-	-	-	-	-
CO2	3	2	2	1	-	3	3	-	-	-	-	-
CO3	3	2	2	2	-	2	2	-	-	-	-	-
CO4	3	2	1	1	-	3	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
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Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
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Continuous Internal Evaluation Pattern:

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Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Estimate the kinetics for chemical and biological reactions

1. On doubling the concentration of a reactant, the reaction rate triples, Find the reaction order

2. The activation energy of a non-catalysed reaction at 37^0C is 83.68 KJ/mol and the activation energy of the same reaction catalysed by an enzyme is 25.10 KJ/mol. Compare the speed of reactions

3. The first order reversible liquid reaction A R, CAo = 0.5 mol/litre , $CR_0 = 0$ takes place in a batch reactor. After 8 minutes, conversion of A is 33.3 % while equilibrium conversion is 66 %. Find the rate equation for this reaction

- **Course Outcome 2 (CO2) :**Analyze the performance of Batch and Continuous reactors and recommend modifications for improvement

1. Recommend a reactor which is better for handling fast reactions. Also write the features and the applications of the same reactor

2. Develop the design equation for constant and varying volume Ideal Batch Reactors

3. A first order gas phase reaction is carried out in a PFR of volume V. In 10 min, conversion is 1/3. What should be the volume of the reactor if conversion required in 10 min is 2/3?

- **Course Outcome 3(CO3):** Predict the conversion for ideal and non-ideal reactors

1. Distinguish between ideal and non-ideal reactors?

2. How conversion depends upon temperature in the case of non- isothermal reactors?

3. Find out the conversion for a first order reaction for micro and macro fluids if the reaction is carried out in a PFR

- **Course Outcome 4 (CO4):** Explain the nature of catalytic reactions with regard to the multiple steps of mass transfer and surface reaction and the concept of rate limiting step

1. Write the role of catalyst in heterogeneous reactions

2. Develop an equation for effectiveness factor for a first order reaction for the diffusion of catalyst through a single cylindrical pore

3. Develop the rate equations for adsorption and chemical reaction in the case of heterogeneous catalytic reactions

Model Question paper

		Total Pages:
Reg No.:_______________		Name:__________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
Course Code: BTT 202		
Course Name: CHEMICAL AND BIOLOGICAL REACTION ENGINEERING		
Max. Marks: 100		Duration: 3 Hours
PART A		
		Answer all questions, each carries 3 marks.
1		Define 'rate of a reaction'. Which are the variables affecting the rate of a reaction?
2		Differentiate elementary and non-elementary reactions
3		What is an ideal reactor? Give examples
4		What is meant by 'Space time'? Write the difference between space time and space velocity?
5		How is E curve related to F curve
6		What is meant by 'Optimum temperature progression'
7		Explain the best model for enzyme kinetics
8		What are biological reactors?
9		What is the role of inhibitors in catalytic processes?

10		Write the characterististics of catalysts	
		PART B	
		Answer any one full question from each module. Each carries 14 marks.	
11		What is meant by activation energy?. Milk is pasteurized if it is heated to 63°C for 30 min, but if it is heated to 74°C it only needs 15 s for the same result. Find the activation energy of this sterilization process.	(14)
		OR	
12		Develop the integral rate expression for a second order reaction A+B+D Products	(14)
13		Prove that, for all positive reaction orders and particular conversion, MFR requires more volume than a PFR	(14)
		OR	
14		At present the elementary liquid-phase reaction A + B R + S takes place in a plug flow reactor using equimolar quantities of A and B. Conversion is 96%, $C_{A0}= C_{B0}=$ 1 mol/lit. If a mixed flow reactor ten times as large as the plug flow reactor were hooked up in series with the existing unit, which unit should come first and by what fraction could production be increased for that setup?	(14)
15		What is the role of RTD, State of aggregations and Earliness/Lateness of mixing in determining reactor behaviour	(14)
		OR	
16		Based on a tracerr test performed on a reaction vessel, responnsses of impulse test conducted on the reaction vessel are reported below. Calculate the mean residence time and variance:	(14)
17		Illustrate the kinetics of cell growth	(14)

Time (Θ)	1	2	3	4	5	6	7	8	9	10	11	12
Tracer concentration C g/l	1.3	4	5	4.5	3.5	2.5	1.7	1.1	0.5	0.2	0	0

		OR	
18		Explain Monod-chemostat model	(14)
19		Develop an equation for effectiveness factor for the diffusion of reactants through a single cylindrical pore by a first order reaction	(14)
		OR	
20		With the help of a neat diagram, explain the constructional details and the working of any 2 three phase catalytic reactors	(14)
****			

Syllabus

Module 1: An overview of chemical & biological reaction engineering

Definition of reaction rate.Basic concepts of chemical kinetics.Classification of chemical reactions.Temperature & concentration dependency of reaction rate.Searching for mechanism- General considerations, hydrogen bromide reaction. Analysis of rate equations Interpretation of batch reactor data: integral and differential method of rate analysis.
Numerical examples.Numerical Problems for evaluation of activation energy and rate equation.

Module 2: Introduction to reactor design

Classification of reactors.Concept of Ideal reactors. Design equations for batch, mixed flow and plug flow reactors. Multiple reactor systems, Plug flow reactor in series and parallel, equal sized mixed reactors in series, mixed flow reactors of different sizes in series, determination of the best system for a given conversion. Numerical problems for evaluation of reactor volume, conversion, their comparison using ideal single and combination of ideal reactors for single/ multiple reactions

Module 3: Non isothermal reactor design

Heat effects in reactors- General graphical design procedure-Energy balance for batch, mixed flow and plug flow reactor. Optimum temperature progression (Qualitative treatment would be sufficient).
Basics of non-ideal flow-Residence time distribution. Measurement of the RTD-Pulse and step input -C, E, F curves-RTD in ideal reactors. Single parameter models of RTD- Tanks in Series and Analysis of Dispersion model (Derivation is not required). Reactor design using RTD data. (Quantitative treatment by solving Numerical problems on moments of RTD)

Module 4: Kinetics of cell growth and enzymes

Cell growth kinetics; substrate uptake and product formation in microbial growth; enzyme kinetics, Michaelis-Menten rate form- Biological reactors – chemostats-Theory of the chemostat. (A preliminary treatment would be sufficient as the topics would be covered in detail in the higher semesters in Enzyme Engineering and Bioprocess Engineering). Monod-chemostat model. (A quantitative treatment for finding out the critical dilution rate, substrate and biomass concentration)

Module 5: Heterogeneous catalytic processes

Classification of catalysts, promoters, inhibitors, catalyst poisons-Rate equations for fluid-solid catalytic-reactions-Mass Transfer between fluid and catalyst surface-Internal transport effects- Pore diffusion combined with surface kinetics- Porous catalysts- Derivation for effectiveness of catalyst with spherical pore, Thiele Modulus. Heat effects during reaction-Performance equation for Reactors containing Porous catalyst particles.Commercially significant types of heterogeneous catalytic reactors.
(No numerical problems are expected from this module. Only qualitative treatment and derivations required)

Text Books

1. Octave Levenspiel, *Chemical Reaction Engineering*, 3/e, Wiley student Education, 2006.
2. H Scott Fogler, *Essentials of Chemical Reaction Engineering,* Pearson Education, 2011

Reference Books

1. J E Bailey, D F Ollis, *Biochemical Engineering Fundamentals*, 2/e, McGraw-Hill ChemicalEngineering Series, 1986.
2. Hill C G, Root T W, *Introduction to Chemical Engineering Kinetics & Reactor Design*, JohnWiley, 2014.
3. Martin Schmal, *Chemical Reaction Engineering, Essentials, Exercises and Examples*, CRC Press, 2011.
4. J M Smith, C*hemical Engineering Kinetics*, McGraw Hill International.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**An overview of chemical & biological reaction engineering**	
1.1	Definition of reaction rate. Basic concepts of chemical kinetics. Classification of chemical reactions. Temperature & concentration dependency of reaction rate	2
1.2	Searching for mechanism- General considerations, hydrogen bromide reaction	2
1.3	Analysis of rate equations. Interpretation of batch reactor data: integral and differential method of rate analysis.	5
1.4	Numerical examples. Numerical Problems for evaluation of activation energy and rate equation	3
2	**Introduction to reactor design**	
2.1	Classification of reactors	1
2.2	Concept of Ideal reactors. Design equations for batch, mixed flow and plug flow reactors	2

2.3	Multiple reactor systems, Plug flow reactor in series and parallel, equal sized mixed reactors in series, mixed flow reactors of different sizes in series, determination of the best system for a given conversion	4
2.4	Numerical problems for evaluation of reactor volume, conversion, their comparison using ideal single and combination of ideal reactors for single/ multiple reactions	2
3	**Non isothermal reactor design**	
3.1	**Heat effects in reactors** -General graphical design procedure-Energy balance for batch, mixed flow and plug flow reactor. Optimum temperature progression	2
3.2	**Basics of non-ideal flow**-Residence time distribution. Measurement of the RTD-Pulse and step input -C, E, F curves-RTD in ideal reactors	2
3.3	Single parameter models of RTD- Tanks in Series and Analysis of Dispersion model. Reactor design using RTD data.	2
3.4	Quantitative treatment by solving Numerical problems on moments of RTD	3
4	**Kinetics of cell growth and enzymes**	
4.1	Cell growth kinetics; substrate uptake and product formation in microbial growth	2
4.2	Enzyme kinetics, Michaelis-Menten rate form	1
4.3	Biological reactors – chemostats-Theory of the chemostat. Monod-chemostat model.	2
4.4	A quantitative treatment for finding out the critical dilution rate, substrate and biomass concentration	2
5	**Heterogeneous catalytic processes**	
5.1	Classification of catalysts, promoters, inhibitors, catalyst poisons. Rate equations for fluid-solid catalytic-reactions	2
5.2	Mass Transfer between fluid and catalyst surface-Internal transport effects- Pore diffusion combined with surface kinetics-Porous catalysts- Derivation for effectiveness of catalyst with spherical pore, Thiele Modulus	2
5.3	Heat effects during reaction-Performance equation for Reactors containing Porous catalyst particles	2
5.4	Commercially significant types of heterogeneous catalytic reactors.	2

BTT204	PRINCIPLES OF BIOCHEMISTRY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: To acquire knowledge of the all the biomolecules, its function and metabolism in maintaining life

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Describe the role of cellular chemicals and their functions.
CO 2	Describe biosynthetic pathways and understand the key aspects of metabolism.
CO 3	Explain cellular energy requirements and how energy is utilized by a cell.
CO 4	Understand the behaviour of enzymes and their kinetics.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	3	2	-	3	-	-	-	-	-	2
CO2	3	-	3	2	-	3	-	-	-	-	-	2
CO3	3	-	3	2	-	2	-	-	-	-	-	2
CO4	3	-	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Describe the role of cellular chemicals and their functions.

1. State three important functions of nucleic acids.

2. How are polysaccharides classified according to their function?

3. Define iso electric pH and its significance.

- **Course Outcome 2 (CO2) :**Describe biosynthetic pathways and understand the key aspects of metabolism.

1. Which are the key steps regulating glycolytic pathway ?

2. How are fatty acids oxidised in the cell. Explain the process with the reactions involved

3. How is the Urea cycle linked to the TCA cycle

- **Course Outcome 3(CO3):** Explain cellular energy requirement and how energy is utilized by a cell.

1. Mitochondrial shuttles are important in generating energy in the cell. Justify ?

2. Give the significance of entropy and enthalpy in a biological context

3. Which are the steps where energy is produced during the complete oxidation of a glucose molecule?

- **Course Outcome 4 (CO4):** Understand the behavior of enzymes and their kinetics.

1. How are enzymes classified according to their function?

2. Describe the two mechanisms of action of enzymes with appropriate diagrams?

3. Describe the mechanism of Ribonuclease ?

Model Question paper

			Total Pages:
Reg No.:_______________			Name:__________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__			
Course Code: BTT 204			
Course Name: PRINCIPLES OF BIOCHEMISTRY			
Max. Marks: 100			Duration: 3 Hours
PART A			
		Answer all questions, each carries 3 marks.	
1		What is the importance of biological buffers? Name two biological buffers and their specific role in Biological systems	
2		Enumerate two functions each of Carbohydrates, lipids, proteins and nucleic acid	
3		Draw the Fischer and Howarth projection of glucose?	
4		Differentiate triglyceride and sphingolipid?	
5		Why are vitamins important in metabolism Give two reasons with examples	
6		Compare and differentiate the principle of ion-exchange chromatography and gel filtration chromatography	
7		What is the difference between oxidative and substrate level phosphorylation?	
8		Why are mitochondrial shuttles important?	
9		How are enzymes inhibited?	
10		What do u understand by the term (a) Activation energy (b) Rate of a reaction	
PART B			
Answer any one full question from each module. Each carries 14 marks.			

11	a)	Describe the animal cell and its organelles with a neat diagram	8)
	b)	What is the function of the following organelles (i) Mitochondria (ii) endoplasmic reticulum (iii) Golgibodies	(6)
		OR	
12	a)	Derive the Hendersen –Haselbalch equation for determining the pH of Buffers	(8)
	b)	Describe the Watson and Crick Model of double stranded DNA with a neat diagram	(6)
13		Describe the different levels of the structural organization of proteins with appropriate diagrams	(14)
		OR	
14		How are lipids and amino acids classified according to the nutritional content? Give the names and structures under each types	(14)
15		Describe glycolysis with all the reactions, enzymes and Energetics both in aerobic and aerobic conditions? Mark neatly the steps at which the pathway is regulated. How is it connected to the TCA cycle?	(14)
		OR	
16		Describe the beta oxidation of fatty acids with appropriate reactions	(14)
17		Describe the electron transport chain	(14)
		OR	
18		Describe all the reactions in photosynthesis	(14)
19	a)	Derive the MichealsMenteen equation for determining the rate of a reaction?	(7)
	b)	What are the factors affecting the rate of a reaction?	(7)
		OR	
20		Describe the mechanism of action of (i) Chymotrypsin (ii) Ribonuclease	14)
		****	

Syllabus

Module 1: Cell organelles and Biomolecules

General features of the cell, organelles and macromolecular assemblies -, importance of buffers in cellular mechanism and pH regulation, Henderson – Hasselbalch equation, Introduction to biomolecules. Role of carbohydrates, proteins, lipids and nucleic acids in cellular functions.

Module 2: Properties of Biomolecules

Biomolecules: Carbohydrate – simple sugars and polysaccharides, complex polymers and glycoproteins; Lipids- structure and chemistry, fatty acids, complex lipids(phospholipids and sphingolipids- functions only) , cholesterol, steroids, prostaglandins and leukotrienes (only significance) ; Proteins- amino acids -structure, nomenclature, primary structure , secondary, tertiary structure of proteins, membrane proteins Nucleic acids – DNA, RNA ,primary structure, secondary, tertiary structure. Chemical properties and reactions of carbohydrates (stereoisomerism included), proteins, lipids and nucleic acids.

Module 3: Metabolism of Biomolecules

Overview of metabolism. Cellular energy requirement for vital functions, energy content of food materials, vitamins and cofactors (Importance only) . Techniques used in the study of metabolism (Chromatographic techniques – Principle only). Major metabolic Pathways: Glycolysis,. TCA cycle, Gluconeogenesis, HMP pathway (pathway and regulatory steps) Regulation of blood glucose level by Insulin and Glucagon, Metabolic regulation by Feedback inhibition (glycolysis only) . Biosynthesis of saturated fatty acids, β-oxidation pathway(only saturated fatty acids), ketone bodies, biosynthesis and degradation of selected amino acids (aromatic amino acids only)

Module 4: Bioenergetics

Bioenergetics –overview, Bioenergy: free and activation energy. Substrate level and oxidative phosphorylation ,ATP synthase complex, formation of ATP. Role of ATP, Redox reactions and reactions that generate reducing equivalents (NADH, NADPH and FADH2)
Photosynthesis & Calvin Cycle (pathway only). Electron transport chain, chemiosmotic coupling, mitochondrial shuttles (glycerol phosphate and malate-aspartate shuttles.).

Module 5: Enzymes

Introduction to enzymes, nomenclature and classification of enzymes, structure–functionality relationships, concept and determination of enzyme activity, concepts of ligand-enzyme binding interactions activation energy and rates of reactions; Michaelis-

Menteen equation, inhibition and allosteric; Enzyme inhibition types- Competitive, Noncompetitive and uncompetitiveinhibitors. Inhibition kinetics.Allosteric regulation of enzymes.Mechanism of action of selected enzymes (Lysozyme, Ribonuclease, Chymotrypsin).

Text Books

1. Vasudevan&SreekumariTextbook of Biochemistry for Medical Students 7th Edition
2. Satyanarayana Biochemistry 5th Edition 2017
3. Jain & Jain Fundamentals of Biochemistry

Reference Books

1. **Lehninger A.L**, **Nelson D.L** and **Cox M.M**, *Principles of Biochemistry*, Palgrave Macmillan
2. **Stryer L, Berg J.M.** and **Tymoczko J.L**, *Biochemistry*, 5th Edn., W.H. Freeman and Co.
3. **Zubay G**, *Biochemistry*, 4th Edition, McGraw Hill Publishers.
4. **Voet. D and Voet. J.G,***Biochemistry*, John Wiley and Sons.
5. **Trevor Palmer, Philip L Boner**, *Enzymes- Biochemistry, Biotechnology and Clinical Chemistry*, Woodhead Publishing, 2007

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Cell organelles and Biomolecules**	
1.1	General features of the cell, organelles and macromolecular assemblies	2
1.2	Importance of buffers in cellular mechanism and pH regulation, Henderson – Hasselbalch equation	2
1.3	Introduction to biomolecules.	1
1.4	Role of carbohydrates, proteins, lipids and nucleic acids in cellular functions.	1
2	**Module 2: Properties of Biomolecules**	
2.1	Biomolecules: Carbohydrate – simple sugars and polysaccharides, complex polymers and glycoproteins;	2
2.2	Lipids- structure and chemistry, fatty acids, complex lipids(phospholipids and sphingolipids- functions only) , cholesterol, steroids, prostaglandins and leukotrienes (only significance)	3
2.3	Proteins- amino acids -structure, nomenclature, primary structure secondary, tertiary structure of proteins, membrane proteins	3
2.4	Nucleic acids – DNA, RNA ,primary structure, secondary, tertiary structure.	2
2.5	Chemical properties and reactions of carbohydrates (stereoisomerism included), proteins, lipids and nucleic acids.	2

3	**Module 3: Metabolism of Biomolecules**	
3.1	Overview of metabolism**.** Cellular energy requirement for vital functions, energy content of food materials, vitamins and cofactors (Importance only) .	2
3.2	Techniques used in the study of metabolism (Chromatographic techniques – Principle only). Major metabolic Pathways: Glycolysis,. TCA cycle, Gluconeogenesis, HMP pathway (pathway and regulatory steps) Regulation of blood glucose level by Insulin and Glucagon, Metabolic regulation by Feedback inhibition (glycolysis only) .	5
3.3	Biosynthesis of saturated fatty acids, β-oxidation pathway(only saturated fatty acids), ketone bodies, biosynthesis and degradation of selected amino acids (aromatic amino acids only)	4
4	**Module 4: Bioenergetics**	
4.1	Bioenergetics –overview, Bioenergy: free and activation energy. Substrate level and oxidative phosphorylation ,ATP synthase complex, formation of ATP. Role of ATP, Redox reactions and reactions that generate reducing equivalents (NADH, NADPH and FADH2)	4
4.2	Photosynthesis & Calvin Cycle (pathway only).	2
4.3	Electron transport chain, chemiosmotic coupling, mitochondrial shuttles (glycerol phosphate and malate-aspartate shuttles.).	2
5	**Module 5: Enzymes**	
5.1	Introduction to enzymes, nomenclature and classification of enzymes, structure–functionality relationships, concept and determination of enzyme activity, concepts of ligand-enzyme binding interactions activation energy and rates of reactions;	4
5.2	Michaelis-Menteen equation, inhibition and allosteric; Enzyme inhibition types- Competitive, Noncompetitive and uncompetitiveinhibitors.	2
5.3	Inhibition kinetics. Allosteric regulation of enzymes.Mechanism of action of selected enzymes (Lysozyme, Ribonuclease, Chymotrypsin).	2

BTT206	BIOPROCESS ENGINEERING	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: Acquaint the students with the various methods of enhancing microbial growth in an industrial perspective

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Illustrate the isolation and preservation of microorganism and development of inoculums.
CO 2	Summarize medium and air sterilization methods
CO 3	Elucidate the mass transfer effects in bioreactors
CO 4	Outline bioreactor scale up and scale down procedures

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	3	-	-	-	3	-	-	3	-	3
CO 2	-	-	3	-	-	-	-	2	-	3	-	3
CO 3	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	3	-	3	-	-	-	-	-	-	3	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Question

Course Outcome 1 (CO1): Illustrate the isolation and preservation of microorganism and development of the inoculum.

1. Illustrate Protoplast fusion method for strain improvement.

2. Compare wild and specific microorganisms

3. Outline the objectives and need for Culture collection and Biological resource centres. Give examples

Course Outcome 2 (CO2) : Summarize medium and air sterilization methods

1 Brief about extinction probability

2. Illustrate the thermal death kinetics of cells and spores

3. Describe the design aspects of batch sterilisation

Course Outcome 3(CO3): Elucidate the mass transfer effects in bioreactors

1. Illustrate the methods for the measurement of Kla

2. Explain the working of a chemostat with recycle.

3. Brief about oxygen uptake in cell cultures

Course Outcome 4 (CO4): Outline bioreactor scale up and scale down procedures

1. Discuss on the need for modelling and control in bioprocesses with the help of available softwares used in bioprocess industry

2. Enumerate the effect of scale on oxygenation in bioprocess.

3. Outline the steps in model building.

Model Question paper

		Total Pages:
Reg No.:_______________		Name:__________________________ _

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT206

Course Name: BIOPROCESS ENGINEERING

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1		Write a short note on protoplast fusion
2		List any three functions of a culture collection centre?
3		What are the general requirements of a fermentation process?
4		Explain the various classifications of fermentation processes
5		Write a note on the concept of X90.
6		Derive the equation for death kinetics of cells and spores.
7		Discuss about chemostat with immobilised cells
8		Explain the static method for the measurement of volumetric oxygen transfer coefficient

9		What do you mean by regime analysis?	
10		Explain about the scale up window.	
		PART B	
		Answer any one full question from each module. Each carries 14 marks.	
11		What are the methods available for the isolation of microorganisms of potential interest? Explain.	(14)
		OR	
12		Define r-DNA technology and describe its application in strain improvement with suitable diagrams. Explain the preservation techniques used for long term preservation of cell cultures.	(14)
13		Briefly explain the different methods used for the measurements of cell viability.	(14)
		OR	
14		Explain any one method for media optimization. How do the age and size of inoculums affect the growth and productivity?	(14)
15		What do you mean by in situ sterilisation? Discuss the design aspects of fibrous type filters used for air sterilization.	(14)
		OR	
16		Explain the design aspects of batch and continuous sterilisation process	(14)
17		Briefly explain oxygen uptake in cell cultures. Explain the role of diffusion in bioprocessing.	(14)
		OR	
18		Describe the ideal reactor operation of batch and fed batch reactors.	(14)
19		How the scale-up based on constant power consumption per volume, mixing time, impeller tip speed (shear) applicable in bioreactor system	(14)
		OR	
20		Comment on the major components in bioprocess modelling . Explain how KLa is measured using the Dynamic method.	(14)

****

Syllabus

Module 1

Isolation of Microorganisms: Isolation, preservation, and improvement of industrially important microorganisms, screening methods, culture preservation.

Strain improvement: mutagenesis, protoplast fusion and r-DNA technology, culture collection and biological resource centres.

Module 2

Fermentation: General requirements of a fermentation process, classification of fermentation processes. Media Optimization

Industrial microorganisms - wild and specific microorganisms, GRAS microorganisms, characteristics of good industrial microorganisms, inoculum, inoculum development and maintenance, effect of age/size of inoculum on cell growth and product formation, cell viability measurements.

Module 3

Sterilization: Medium & air sterilisation methods, del factor, batch & continuous sterilization. Design of depth filter and estimation of efficiency, in-situ sterilization in fermenter, thermal death kinetics of cells and spores, extinction probability, batch and continuous steriliser design aspects, sterilisation of liquid wastes.

Module 4

Mass transfer in bioprocess

Role of diffusion in bioprocessing, oxygen uptake in cell cultures, oxygen transfer in bioreactors, measurement of volumetric oxygen transfer coefficient. Ideal reactor operation, batch, fed batch and continuous operation of mixed bioreactors, chemostat with immobilized cells, chemostat with cell recycle

Module 5

Modelling and optimisation of bioprocesses-definition of a model, need for modelling and control in bioprocesses, steps in model building, Scale-up and scale-down of bioreactors, correlations for oxygen transfer, effect of sale on oxygenation, mixing, bioreactor scale-up based on constant power consumption per volume, mixing time, impeller tip speed (shear), mass transfer coefficients, regime analysis of bioreactor processes.

Text Books

1. P F StanburyDr. A Whitaker, Principles Of Fermentation Technology, Elsevier, Second edition 1995

2. Pauline M. Doran Bioprocess Engineering Principles Academic press - 2nd Edition 2012

Reference Books

1. Rajiv Dutta, *Fundamentals of Biochemical Engineering*, Springer, 2008.

2. Brian McNeil, Linda Harvey (Eds.), *Practical Fermentation Technology*, Wiley, 2008.

3. J E Bailey, D F Ollis, *Biochemical Engineering Fundamentals*, 2/e, McGraw-Hill Chemical Engineering Series, 1986.

4. Michael L Shuler, FikretKargi, *Bioprocess Engineering Basic Concepts*, Prentice Hall, 1992.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	ISOLATION OF MICROORGANISMS AND STRAIN IMPROVEMENT	
1.1	Isolation & Screening methods	2
1.2	Preservation	1
1.3	Improvement of industrially important microorganisms	1
1.4	Mutagenesis , Protoplast fusion, r -DNA technology	3
1.5	Culture collection and biological resource centres	1
2	FERMENTATION AND INDUSTRIAL MICROORGANISMS	
2.1	General requirements of a fermentation process, Classification of fermentation processes	2
2.2	Media Optimization	1
2.3	Wild and specific microorganisms & GRAS microorganisms, Characteristics of good industrial microorganisms	2
2.4	Inoculums development and maintenance,	1
2.5	Effect of age/size of inoculum on cell growth and product formation	1
26	Cell viability measurements.	1
3	STERILISATION	
3.1	Medium & air sterilisation methods, Batch sterilisation and DEL factor	2
3.2	Continuous sterilisation, In -situ sterilisation in fermenter	3

3.3	Thermal death kinetics of cells and spores, Extinction probability	2
3.4	Batch and continuous steriliser design aspects, Sterilisation of liquid wastes.	2
4	MASS TRANSFER IN BIOPROCESS	
4.1	Role of diffusion in bioprocessing, Oxygen uptake in cell cultures	2
4.2	Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient	2
4.3	Ideal reactor operation, Batch, fed batch and continuous operation of mixed bioreactors	4
4.4	Chemostat with cell recycle	2
5	MODELLING AND OPTIMISATION OF BIOPROCESS	
5.1	Definition of a model, need for modelling and control in bioprocesses, Steps in model building	2
5.2	Scale-up and scale-down of bioreactors, Correlations for oxygen transfer	2
5.3	Effect of sale on oxygenation, Mixing	2
5.4	Bioreactor scale-up based on constant power consumption per volume, Mixing time	2
5.5	Impeller tip speed (shear), Mass transfer coefficients, Regime analysis of bioreactor processes.	2

BTL202	BIOCHEMISTRY LABORATORY	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: Practical skills in handling and characterising biomolecules

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Prepare reagents for various biochemistry experiments.
CO 2	Qualitative and quantitative analysis of various biomolecules
CO 3	Perform enzyme isolation, estimation and assay
CO 4	Use some basic analytical instruments like spectrophotometer

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	1	-	-	1	-	3	2	-	3
CO 2	-	-	-	1	-	-	1	-	3	2	-	3
CO 3	-	-	-	1	-	-	1	-	3	2	-	3
CO 4	-	-	-	1	-	-	1	-	3	2	-	3

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting) : 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering the entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Syllabus

1. Preparation of buffers
2. Qualitative tests for Carbohydrates
3. Qualitative tests for Amino Acids
4. UV spectra of
   i. DNA
   ii. Protein

5. Quantitative estimation of sugars (any one)
   A. Estimation of reducing sugars by the Nelson Somogyi method.
   B. Estimation of reducing sugars by Benedict's method.
   C. Estimation of reducing sugars by the DNS method.
   D. Estimation of fructose by the Resorcinol method.

06 .Quantitative estimation of amino acids and proteins (any two)
   A. Estimation of protein Biuret method.
   B. Estimation of protein by Folin's method.
   C. Estimation of amino acid by sugars by the Ninhydrin method
   D. Estimation of Tyrosine by sugars by the Folin's method

07.Quantitative estimation of cholesterol by Zak's method
08.Quantitative estimation of nucleic acids
   A. Estimation of DNA by Diphenylamine reagent method.
   B. Estimation of RNA by Orcinol reagent method.

09.Enzyme isolation: (any 1)

i. Amylase from sweet potato or saliva
ii. Urease from horse gram
iii. Peroxidase from sweetpotato/ potato
iv. Papain from Papaya

10.Saponification of Fats
11.Paper Chromatography of amino acids.
12.Protein precipitation by Ammonium sulphate.
13.Estimation of AL3+ by flourimetry.
14.Estimation of SO-4 by nephelometry
15.Extraction of cholesterol from egg yolk

Textbooks

1. S. Sadasivam,BiochemicalMethods,New Age International, 1996.
2. Wilson K and Walker J, *Principles and Techniques of Practical Biochemistry*, Cambridge University Press.

Reference Books

1. Rodney and Boyer, *Modern Experimental Biochemistry*, Pearson education, India.
2. Alexander J. Ninfa and David P. Ballou, *Fundamental Laboratory Approaches for Biochemistry and Biotechnology*, Fitzgerald Science Press Inc, USA.
3. David T. Plummer –*An introduction to Practical Biochemistry*, McGraw- Hill.

Course Contents and Lecture Schedule

No	Topic	No. of hours
1	Preparation of buffers	3
2	Qualitative tests for Carbohydrates	6
3	Qualitative tests for Amino Acids	3
4	UV spectra of DNA and protein	3
5	Quantitative estimation of sugars	3
6	Quantitative estimation of amino acids	3
7	Quantitative estimation of proteins	3
8	Quantitative estimation of cholesterol by Zak's method	3
9	Quantitative estimation of nucleic acids	3
10	Enzyme isolation: (any one)	3
11	Saponification of Fats	3
12	Saponification of fats	3
13	Paper Chromatography of amino acids	3
14	Protein precipitation by ammonium sulphate	3
15	Estimation of Al^{3+} by flourimetry	3

16	Estimation of Sulphate by nephelometry	3

BTL204	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

This course aims to familiarize students with the basic instrumental techniques necessary for analysis of bioprocess systems. The techniques shall be learned in a flawless manner such as to enable the students to identify and implement appropriate techniques for analytical applications in diverse bioprocess contexts.

Prerequisite: Knowledge on basic tools needed for the identification of biomolecules

Course Outcomes: After the completion of the course the student will be able to

CO 1	Capability to perform and develop knowledge for the appropriate selection of instruments for the successful analysis of biomolecules.
CO 2	Critically evaluate the strengths and limitations of the individual analytical techniques with respect to selectivity and sensitivity for solving bioengineering problems.
CO 3	Possess and be capable of applying a knowledge of modern analytical techniques.
CO 4	Apply the knowledge and skills acquired to analyze and interpret experimental data obtained from different instrumental measurements and communicate results effectively.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	3	2	-	-	-	-	3	2	-	-
CO 2	-	-	2	2	-	-	-	-	3	2	-	-
CO 3	-	-	2	2	2	-	-	-	3	2	-	-
CO 4	-	-	2	2	-	-	-	-	3	2	-	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting) : 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering the entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Verify the Beer-Lambert's law-using UV-Vis spectrophotometer.

2. Find out the absorption maxima of the given sample.

3. **Course Outcome 2 (CO2)**

1. Determine the molecular weight of the given protein sample.

2. Precipitate the given sample of protein by suitable method.

3. Prepare the absorption spectra of nucleotides

Course Outcome 3(CO3):

1. Separate the given sample mixture of amino acids and determine the Rf value.

2. Extract the given lipid sample and separate using thin layer chromatography

3. Analyse the given protein by SDS- PAGE method.

3. **Course Outcome 4 (CO4):**

1. Demonstrate the isolation of leaf pigments by suitable chromatography technique.

2. Perform the isolation of different fractions from cells using centrifugation.

3. Analyse the sugars in fruits by thin layer chromatography.

Syllabus

(10 experiments are mandatory) - *Visits to research institutions and industries for demonstration of the various analytical instruments may also be arranged.*

1. Atomic absorption spectroscopy-Precision and validity of an experiment using absorption spectroscopy.
2. Colorimetry and spectrophotometry - Validate Beer-Lambert's law.
3. Determination of absorption maxima of the given sample.
4. UV spectra of Nucleic Acids
5. Paper chromatography - Separation of amino acids by paper chromatography & determination of Rf value.
6. Thin Layer chromatography - Extraction of lipids and separation using thin layer chromatography.
7. Column chromatography -Determination of molecular weight of macromolecules

8. Separation and identification of protein on gel electrophoresis
9. Separation & identification of nucleic acids on gel electrophoresis.
10. PCR
11. Mass Spectrometry
12. IR spectroscopy
13. HPLC
14. NMR
15. Estimation of Thiamine and Riboflavin by Fluorimetry.

Textbooks

1. Wilson K and Walker J, Principles and Techniques of Practical Biochemistry, Cambridge University Press.

Reference Books

1. Rodney and Boyer, Modern Experimental Biochemistry, Pearson education, India.
2. Alexander J. Ninfa and David P. Ballou, Fundamental Laboratory Approaches for Biochemistry and Biotechnology, Fitzgerald Science Press Inc, USA.
3. David T. Plummer –An introduction to Practical Biochemistry, McGraw- Hill.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Atomic absorption spectroscopy-Precision and validity of an experiment using absorption spectroscopy.	1
2	Colorimetry and spectrophotometry - Validate Beer-Lambert's law.	2
3	Determination of absorption maxima of the given sample.	3
4	UV spectra of Nucleic Acids	3
5	Paper chromatography -Separation of amino acids by paper chromatography & Determination of Rf value.	3
6	Thin Layer chromatography - Extraction of lipids and separation using thin layer chromatography.	3
7	Column chromatography - Determination of molecular weight of macromolecules	3
8	Separation and identification of protein on gel electrophoresis	3
9	Separation & identification of nucleic acids on gel electrophoresis.	3

10	PCR	3
11	Mass Spectrometry	3
12	IR Spectroscopy	
13	HPLC	3
14	NMR	3
15	Estimation of Thiamine and Riboflavin by Fluorimetry	3

SEMESTER -4
MINOR

BTT282	FERMENTATION TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: A basic knowhow on the various processes in fermentation for the development of biologically relevant products

Prerequisite: Basics in Bioprocess engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	Illustrate the introduction to fermentation, design of fermenter and factors affecting fermentation process
CO 2	Analyse microbial growth kinetics, comparison of batch and continuous culture processes and preservation of industrially important microorganism
CO 3	Formulate media for industrial fermentation and understand medium optimization process
CO 4	Understand the product development, product recovery and various purification strategy for fermentative products
CO 5	Practice the basics of Industrial production of primary metabolites and secondary metabolites and packing and labelling through good manufacturing practices

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	-	3	-	-	--	-	2	-	3	-	
CO 2	-	-	-	-	-	-	-	-	-	3	-	3
CO 3	-	-	-	-	-	-	-	-	-	3	-	3
CO 4	-	-	3	-	-	-	-	3	-	3	-	3
CO 5	-	-	-	-	-	3	-	3	-	3	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Illustrate the introduction to fermentation, design of fermenter and factors affecting fermentation process

1. Illustrate the working of an airlift fermenter

2. Brief about the factors affecting fermentation process

3. Outline the different types of fermentation processes.

Course Outcome 2 (CO2) : Analyse microbial growth kinetics, comparison of batch and continuous culture processes and preservation of industrially important microorganism

1 Draw a microbial growth curve and explain the different phases.

2. Explain the kinetics of continuous culture.

3. Write note on the preservation methods used for microbial cultures

Course Outcome 3(CO3): Formulate media for industrial fermentation and understand medium optimization process

1 Brief about the factors to be considered during the selection of carbon and nitrogen sources in the media.

2. Write a short note on animal cell media.

3. Describe the optimisation of fermentation media.

Course Outcome 4 (CO4): Understand the product development, product recovery and various purification strategy for fermentative products

1. Discuss about the methods for the removal of cells and solid matters.

2. Explain the principle of HPLC.

3. Outline the physical and chemical cell disruption methods.

Course Outcome 5 (CO5): Practice the basics of Industrial production of primary metabolites and secondary metabolites and packing and labelling through good manufacturing practices

1. With a neat sketch outline the production of any one intracellular enzyme.

2. Explain the production of organic acid.

3. List any four criteria to be followed during the production process.

Model Question paper

		Total Pages:
Reg No.:_______________		Name:__________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
Course Code: BTT 282		
Course Name: FERMENTATION TECHNOLOGY		
Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Write a short note on Cyclone column
	b)	Discuss about fed batch fermentation process
	c)	Explain the importance of preservation of microorganism
	d)	Explain the isolation process of antibiotic producing organisms.
	e	Explain about medium formulation in a fermentation process

	)	
	f)	Discuss in detail about Non-nutritional media supplement
	g)	Elaborate on any one physical method of Cell disruption
	h)	Explain the principle of centrifugation.
	i)	Enumerate the factors need to be considered for industrial production of Primary metabolites
	j)	List out the different biosafety levels

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Illustrate the design and working of airlift fermenter and cyclone column	(14)
		OR	
3		Describe the different physical, chemical and biological factors affecting fermentation process	(14)
4		Discuss the different methods for the isolation and preservation of industrially important microorganisms.	(14)
		OR	
5		Explain the kinetics of batch and continuous cultures.	(14)
6		Describe Placket and Burman method of media optimisation. What are the requirements of a good production media?	(14)
		OR	
7		Explain the different types of media and the role of each component in animal cell culture.	(14)
8		Write notes on i) Adsorption chromatography ii) Ion exchange chromatography	(14)
		OR	
9		What is the theory of Filtration process? Explain about types of filters-batch-continuous filters	(14)
10		Discuss on the production of butanol in a fermentation process industry	(14)
		OR	

11		What are the forms of IPR and the process of patenting?	(14)
****			

Syllabus

Module 1

Introduction to fermentation-Design of fermenter-body construction-aeration system-agitation system-baffles- sensors. Type of fermenters- Waldhof, Tower, Deep jet, Cyclone column, packed tower and airlift fermenter Different types of fermentation process-batch, continuous, fed batch.Factors affecting fermentation process- physical, chemical and biological factors.

Module 2

Microbial Growth Kinetics: Batch culture-continuous culture-fed batch system-biomass productivity-metabolite productivity-continuous brewing-comparison of batch and continuous culture. Isolation and preservation of industrially important microorganisms.Preservation of industrially important microorganisms.

Module 3

Media for industrial fermentation- introduction-typical media-medium formulation-water-energy sources-carbon sources-factors affecting the selection of carbon source-carbohydrates, oils and fats, nitrogen source, minerals, growth factors, chelators, buffers, antifoam agents, pH.Medium optimization-animal cell media-serum-serum free media-protein free media. Non-nutritional media supplement.

Module 4

Product development and product recovery-cell.Introduction to purification of fermentative products-removal of microbial cells and other solid matters.Cell disruption-physical-mechanical-chemical-enzymatic methods.Product recovery-chromatography-adsorption-ion-exchange-HPLC. Filtration- types of filters-batch-continuous filters centrifugation. Liquid/liquid extraction and dialysis.

Module 5

Introduction to fermentative production technology: Industrial production of Primary metabolites and secondary metabolites. Introduction to enzyme production – Intracellular and Extracellular Enzymes- Production of Proteases.Fermentative production of ethanol-acetone- butanol, Organic acids- citric acid.Amino acids- lysine and phenylalanine, Vitamins- riboflavin and ascorbic acid.Antibiotics-penicillinSCP production.

Packing and labelling. Good Manufacturing Practices, Biosafety- laws and concerns at different levels- individual, institution and society. Forms of IPR and process of patenting.

Text Books

1.Peter F. Stanbury Allan Whitaker Stephen Hall, *Principles of Fermentation Technology*,2nd Edition, Butterworth-Heinemann 1995

2.Michael L Shuler, FikretKargi, Bioprocess Engineering Basic Concepts, Prentice Hall, 1992.

3.WulfCruger and AnnelieseCrueger, Biotechnology: *A Textbook of Industrial Microbiology*, 2nd Edition, Panima Publishing Corporation, 2004.

Reference Books

1.Michael C Flickinge (Ed.), *Upstream Industrial Biotechnology*, Volumes 1 & 2, Wiley 2013

2. Brian McNeil, Linda Harvey (Eds.), *Practical Fermentation Technology*, Wiley, 2008.

3. J E Bailey, D F Ollis, *Biochemical Engineering Fundamentals*, 2/e, McGraw-Hill Chemical Engineering Series, 1986.

4. Bioprocess Technology, P.T. Kalichelvan and I Arul Pandi, 2009,MJP Publishers, Chennai.

5. Bioprocess Technology- Kinetics and reactors, Antan Moser and Philip Manor,.1998, Springer

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**INTRODUCTION TO FERMENTATION**	
1.1	Design of fermenter-body construction-aeration system-agitation system-baffles- sensors	3
1.2	Type of fermenters- Waldhof, Tower, Deep jet, Cyclone column, packed tower and airlift fermenter	3
1.3	Different types of fermentation process-batch, continuous, fed batch.	2
1.4	Factors affecting fermentation process- physical, chemical and biological factors.	1
2	**MICROBIAL GROWTH KINETICS**	

2.1	Batch culture-continuous culture-fed batch system	3
2.2	Biomass productivity-metabolite productivity-continuous brewing-comparison of batch and continuous culture.	3
2.3	Isolation and preservation of industrially important microorganisms.	2
3	**MEDIA FOR INDUSTRIAL FERMENTATION**	
3.1	Introduction -typical media-medium formulation-water-energy sources-carbon sources-factors affecting the selection of carbon source-carbohydrates, oils and fats, nitrogen source, minerals, growth factors, chelators, buffers, antifoam agents, pH.	3
3.2	Medium optimization-animal cell media,	2
3.3	serum free media-protein free media	1
3.4	Non-nutritional media supplement.	1
4	**PRODUCT DEVELOPMENT AND PRODUCT RECOVERY**	
4.1	Introduction to purification of fermentative products-removal of microbial cells and other solid matters.	2
4.2	Cell disruption-physical-mechanical-chemical-enzymatic methods.	2
4.3	Product recovery-chromatography-adsorption-ion-exchange-HPLC.	3
4.4	Filtration- types of filters-batch-continuous filters centrifugation.	2
4.5	Liquid/liquid extraction and dialysis.	2
5	**INTRODUCTION TO FERMENTATIVE PRODUCTION TECHNOLOGY**	
5.1	Industrial production of Primary metabolites and secondary metabolites. Introduction to enzyme production – Intracellular and Extracellular Enzymes- Production of Proteases.	2
5.2	Fermentative production of ethanol-acetone- butanol, Organic acids- citric acid.	3
5.3	Amino acids- lysine and phenylalanine, Vitamins-riboflavin and ascorbic acid. Antibiotics-penicillinSCP production.	2
5.4	Packing and labelling. Good Manufacturing Practices, Biosafety-laws and concerns at different levels- individual, institution and society.	2
5.5	Forms of IPR and process of patenting.	1

BTT284	INTRODUCTION TO MOLECULAR BIOLOGY	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Understand the DNA, its functions and methods of manipulation

Prerequisite: Basic Biology (+2)

Course Outcomes: After the completion of the course the student will be able to

CO 1	Lays out the groundwork for understanding the fundamental aspects of life through molecular studies
CO 2	Prioritize, Recognize and Undertake advanced courses based on Molecular Biology interactions of life systems and cellular biology
CO 3	Judge molecular level mechanisms in the biological processes
CO 4	Appraise the theoretical aspects of cellular activities and functioning

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	2	-	-	-	-	-	-	-	-	2
CO 2	-	-	2	-	-	-	-	2	-	2	-	-
CO 3	3	-	3	-	-	-	-	-	-	-	2	-
CO 4	-	-	2	-		2	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State the components of DNA.

2. List the enzymes used in Molecular Biology.

3. Characterize the sequence of cellular events through Central dogma .

Course Outcome 2 (CO2)

1. Illustrate the Molecular techniques used in Modern Virology

2. PCR is a mandatory requirement in emerging disease diagnosis. Justify.

3. Signify the replication process through eukaryotic replication

Course Outcome 3(CO3):

1. Assess the role of Transcription factors in the synthesis of protein

2. Give reasons and prove that transcription is the key factor in cellular activities

3. Describe the process of RNA biosynthesis

Course Outcome 4 (CO4):

1. Define and judge the Genetic code as a basic component of hereditary features

2. Generate reasons to prove that Wobble hypothesis is error prone. Judge the hypothesis as a mandatory requirement for cellular function.

3. State the importance of DNA replication. Signify the reasons to have semi conservative mode of replication in living cells

Model Question paper

		Total Pages:
Reg No.:_______________		Name:__________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
Course Code: BTT 284		
Course Name: INTRODUCTION TO MOLECULAR BIOLOGY		
Max. Marks: 100		Duration: 3 Hours
PART A		

		Answer all questions, each carries 3 marks.
1	a)	.Brief up the enzymatic requirements for cutting and pasting DNA in gene cloning
	b)	Discuss in detail the historical events that lead to development of Molecular Biology
	c)	Define Origin of replication. How is it important in the process of replication
	d)	Signify semi conservative replication in living cells
	e)	Define Transcription. Comment on the significance of Transcription bubble and explain the process of Transcription
	f)	Comment on collinearity of genes and proteins
	g)	Define codon. Detail the functions of the genetic code
	h)	Propose Wobble hypothesis as essential subject in genetic level cellular interactions
	i)	Discuss on the features of any one plasmid vector
	j)	Point out the steps involved in Molecular cloning

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Appraise the types of DNA with reference to its functions	(8)
	b)	Discuss in detail the importance of Central Dogma in cellular system	(6)
		OR	
3		Discuss in detail the types of RNA and its functions	(14)
4		Categorize the events in replication with the aid of neat and labelled diagram	(14)
		OR	
5		Generate reasons to prove that DNA Polymerases is necessary for cellular functions. Explain in detail the process involved in polymerisation	(14)
6	a)	Sketch and explain mRNA processing	(6)
	b)	Signify the process of RNA biosynthesis	(8)
		OR	
7		Define Transcription. Comment on the significance of Transcription bubble and explain the process of Transcription	14)
8		Outline translation representing it through diagrams and stepwise events	(14)
		OR	
9		Discuss in detail the importance of post translational modifications in cellular system	(14)
10		Define PCR. Summarize the role of PCR as diagnostic tool in detecting emerging infections	(14)
		OR	
11		Shortlist the applications of Molecular Biology	(14)
		****	

Syllabus

Basics of Molecular Biology (structure & function), Structure of DNA and RNA and their types, Significance of the flow of genetic information through central dogma, replication, Expression of genetic information, Transcription, Post Transcriptional modifications, Genetic code, Translation, Post translational modifications, Application of Molecular Biology and use of molecular approaches in Modern science

Module 1: Introduction: Historical perspective, composition of RNA and DNA. Structure of RNA and DNA, Types of RNA. Central dogma of molecular biology, Enzymes in Molecular Biology: Nucleases, RibonucleaseSetc

Module 2:Replication of DNA: Semi conservative nature,replication origin and site, and structure and DNA. Replication of double stranded DNA, direction of replication, discontinuous replication, Okazaki Fragments. DNA polymerase I II and III, DNA ligase, DNA topoisomerases.Significance of Replication.

Module 3: Transcription: Colinearity of genes and proteins, RNA polymerase I, II and III. RNA biosynthesis in prokaryotes and eukaryotes; initiation, elongation and termination. Processing of mRNA, cap addition, poly A tail addition.Significance of Transcription.

Module 4: Translation: Genetic code, triplet codon, universality, features of the genetic code, assignment of codons, degeneracy, wobble hypothesis, Steps involved in Translation. Post translational modifications. Significance of Translation

Module 5: Application of Molecular Biology: Cloning vectors, Plasmid and Viral vectors, Molecular Cloning, Polymerase Chain Reaction, DNA fingerprinting, RFLP. Use of molecular techniques in evolutionary biology such as population genetics and phylogenetics etc.

Text Books

1. Alberts, B., Bray, D. and Hopkin, K. (2004). Essential Cell Biology.3rd edition. Garland Science, U.S.A

2. Cox, M., Michael.,Nelson,L.D. (2008). Principles of Biochemistry.5th edition.W.H.Freeman and company, Newyork.

Reference Books

1. Dale,W.J. and Schontz, V.M.(2007). From Genes to Genomes. John Wiley &Sons ltd., England.

2. David. A. Micklos, Greg.A. Freyer and David A. Crotty, (2003). DNA Science A First Course, 2nd edition, Cold SpringHarbor Laboratory Press, New York.

3. Flint. S.J, L.W. Enquist, R.M. Krug, V.R. Racaniello and A.M. Skalka, (2000) Principles of Virology, ASM Press, Washington D.C

4. Gerald Karp (1996). Cell and Molecular Biology – Concepts and Experiments. John Wiley and Sons, Inc., New York.

5. Griffiths AJF, H.J. Muller., D.T. Suzuki, R.C. Lewontin and W.M. Gelbart (2000). An introduction to genetic analysis. W.H. Freeman , New York

6. Harvey Lodish, Arnold Berk, Paul Matsudaira, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, S. Lawrence Zipursky and James Darnell. (2003). Molecular Cell Biology, W.H. Freeman and Company, New York.
7. Kieleczawa,J. (2006). DNA Sequencing II.Jones and Bartlett Publishers, Canada.
8. Koenberg, A.and Baker, A.T. (2005). DNA Replication.2nd edition. University Science Book, California.
9. Nickoloff,A.J. and Hoekstra,F.M. (1998). DNA Damage and repair.Volume II. Humana Press Inc., New Jersey.
10. Watson, Baker, Bell, Gann, Levine and Losick. (2006). Molecular Biology of the Gene, 5 th edition, Pearson Education.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Introduction to Molecular Biology	
1.1	Historical perspective, composition of RNA and DNA.	3
1.2	Structure of RNA and DNA, Types of RNA. Central dogma of molecular biology,	3
1.3	Enzymes in Molecular Biology: Nucleases, Ribonucleaseetc	3
2	Replication of DNA	
2.1	Semi conservative nature,replication origin and site, and structure and DNA.	3
2.2	Replication of double stranded DNA, direction of replication, discontinuous replication, Okazaki Fragments	3
2.3	DNA polymerase I II and III, DNA ligase, DNA topoisomerases. Significance of Replication.	3
3	Transcription	
3.1	Collinearity of genes and proteins, RNA polymerase I, II and III. RNA biosynthesis in prokaryotes and eukaryotes	3
3.2	Initiation, elongation and termination.	3
3.3	Processing of mRNA, cap addition, poly A tail addition. Significance of Transcription	3
4	Translation	
4.1	Genetic code, triplet codon, universality, features of the genetic code	3
4.2	Assignment of codons, degeneracy, wobble hypothesis.	3
4.3	Steps involved in Translation. Post translational modifications. Significance of Translation	3
5	Application of Molecular Biology	

5.1	Cloning vectors: Plasmid and Viral vectors, Molecular Cloning	3
5.2	Principle and application of Molecular Biology techniques such as Polymerase Chain Reaction, DNA fingerprinting, RFLP.	3
5.3	Use of molecular techniques in evolutionary biology such as population genetics and phylogeneticsetc	3

BTT286	PROCESS SAFETY	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: To gain knowledge on the safety procedures in a biochemical industry

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Outline the methods for analysis of hazards, risks and accidents in process industries
CO 2	Explain the concept and philosophy of industrial safety.
CO 3	Outline the policies, legislations and conventions for safety in industrial practice
CO 4	Highlight the means and measures for ensuring personal safety in process industries.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	3	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	3	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Outline the methods for analysis of hazards, risks and accidents in process industries.

1. Illustrate hazard identification techniques
2. Differentiate between FTA and ETA
3. What are the common errors that may lead to accidents in process industries?

- **Course Outcome 2 (CO2) :** Explain the concept and philosophy of industrial safety

1. Write the role of industrial safety officer
2. What is the significance of safety audits
3. What are the benefits of industrial safety?

- **Course Outcome 3(CO3):** Outline the policies, legislations and conventions for safety in industrial practice

1. Exemplify the Factories Act 1948.
2. How can we ensure safety industries?
3. On what basis industrial safety policies are set?

Course Outcome 4 (CO4): Highlight the means and measures for ensuring personal safety in process industries.

1. Write about personal safety in industries
2. Classify personal protective equipment?
3. How can we ensure personal safety in process industries?

Model Question paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 286

Course Name: PROCESS SAFETY

Max. Marks: 100 | Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Define hazard, write any two examples
	b)	Explain FMEA
	c)	What are the duties and responsibilities of a supervisor
	d)	Explain the preparation and assessment of safety audit
	e)	Explain fire triangle
	f)	How fire is classified?
	g)	Write examples for electrical hazard
	h)	How can we ensure electrical safety in industries?
	i)	Explain about onsite emergency planning
	j)	Briefly explain material storage in industries

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Explain HAZOP with example	(6)
	b)	Compare and contrast fault tree and event tree analysis methods for hazard analysis.	(8)

		OR	
3		Illustrate hazard identification techniques	(14)
4		Explain about ILO Convention	(14)
		OR	
5	a)	Specify the elements of safety audit.	(8)
	b)	What are the duties and responsibilities of a plant worker?	(6)
6		Demonstrate the classification of fire and extinguishers	(14)
		OR	
7	a)	Explain the resuscitation and first aid.	(6)
	b)	What are the different types of explosion?	(8)
8		Exemplify the electrical safety considerations	(14)
		OR	
9		Explain the precautions in processes and operations involving explosives	(14)
10		Explain the general considerations and types of storage of chemicals	(14)
		OR	
11		Demonstrate the chemical accident prevention and explain any two case studies	(14)
****			

Syllabus

Module 1: Hazard, Risk and Accident

HAZARD: Introduction to hazard, causes, identification, evaluation & control of hazard. HAZOP analysis, Sources for information on hazard evaluation.
OCCUPATIONAL HAZARDS & DANGEROUS CHEMICALS: Introduction to occupational health hazards & dangerous properties of chemicals, dust, gases, fumes, mist, vapours, smoke and aerosols, concepts of threshold limit values, classification of hazards.
RISK ANALYSIS: Definition of risk, risk analysis, introduction to Failure Mode & Effect Analysis (FMEA), Fault Tree Analysis (FTA), and Event Tree Analysis (ETA).
ACCIDENT: Definition of accidents, classification of accidents, need for the analysis of accidents, methods adopted for reducing accidents, investigation of accidents, safety slogans, principles of accident(Heinrich theory), accident ratio study, identification of unsafe mechanical/ physical conditions, identification of unsafe acts. Frequency rate, prevention methods.

Module 2: Industrial Safety

SAFETY CONCEPT : Introduction to safety management, safety policy, safety committee, safety review, responsibility of management, safety officers duties & responsibilities, safety targets, objectives, standards, practices and performances. Motivation & communication as part of a safety programme. Duties & responsibility of an owner, duties and responsibilities of a worker, role of a supervisor, role of a safety engineer.
ILO CONVENTION: Introduction of ILO and conventions.
FACTORIES ACT 1948 (Amended): Health - cleanliness, disposal of waste, ventilation and temperatures, dust & fumes, drinking water, lighting, latrines & urinals. safety - fencing of machineries, work on or near machinery in motion, hoists and lifts, pressure plants, floors, stairs and means of escape, protection against fumes & gases, safety offers. Welfare - washing facilities in dry clothing, storing, sitting, first aid appliances, canteen, and shelters for rest & lunch, crèches, welfare offers, rights & obligations of workers.
PREPARATION & ASSESSMENT OF SAFETY AUDIT : Introduction to safety checklist, plant safety inspection, safety precautions adopted in the plant, safety tag system, safety audit report objective of safety audit, type of audit, audit team, elements of safety audit, method of audit, audit steps, concept and layout of audit report.
WELFARE & TRAINING: General provision, drinking water, sanitary & washing, cloakrooms, facilities for food & drink, shelters & living accommodation, information & training.

Module 3: Fire Hazard

BASIC PHYSICS AND CHEMISTRY RELATED TO FIRE: Definition of matter and energy, physical properties of matter like density, specific gravity, relative density, vapour density, melting & boiling point, flammable limits, latent heat, etc, effects of density on behaviour of gases, basics of oxidizing and reducing agents, acids. Flammable liquids -classification and types of tanks, dust and explosion, liquid and gas fires, LPG. UCVE, BLEVE, slope over, boil over, gas laws, P-V-T relation for perfect gas.
ANATOMY OF FIRE: Definition of combustion, elements of combustion, products of combustion, heat of reaction and calorific value, flash point, fire point, ignition temperature and spontaneous combustion. fire triangle, fire tetrahedron, fire pyramid, source of heat(chemical, mechanical, electrical, nuclear etc.), classification of fire and method of fire extinguishment, oxygen and its effects on combustion, mode of heat transfer(conduction, convection & radiation).
CLASSIFICATION OF FIRE & EXTINGUISHERS: Classification of fire and types of extinguishers, maintenance, method of operation, halon and its detrimental effect on environment. Alternatives of halon.Types of fire extinguishing agents, rating system for portable fire extinguishers, limitation of fire extinguishers, inspection requirement.
HOSE & PUMPS, WATER TENDER: fire service hose & hose fittings, fixed fire Fighting installations ropes & lines, practical firemanship, small & special gears, water tender. Types of fire hoses, its construction, causes of decay care & maintenance. Types of hose fittings, identification and use of hose fittings.Types of FFF installations -testing care & maintenance.

HYDRANT, DETECTORS & LADDERS: Introduction to hydrant & hydrant fittings, water supply requirements for fire fighting, introductions to pump & primers, detectors & ladders.
BREATHING SETS: Classification and selection of respiratory personal protective devices, instruction & training in the use, maintenance and care of self containing breathing apparatus.
RESUSCITATION & FIRST AID: Burns, fractures, toxic ingestion, bleeding, wounds and bandaging, artificial respiration, techniques of resuscitation.

Module 4: Electrical & Chemical safety

BASIC PHILOSOPHY OF SAFETY: Peculiarities & parameters governing the safety in construction e.g. site planning, layout, safe access / egress.
Construction Industry: General safety precautions related to construction industry, safety in the use of construction machinery. Industrial lighting: Introduction to lighting, ventilation, heat stress, cold Stress, noise & vibration.
ELECTRICAL SAFETY: Electrical hazards, static electricity. Identification and zoning of hazardous areas, classification of products.
EXCAVATIONS, DEMOLITIONS & STRUCTURAL FRAMES: Safety related to excavation, demolitions, framework & concrete Work, pile driving and work over water.
SAFETY IN MELTING, BOILERS: Hazards in process of melting (furnaces), casting, and forging. Automatic manufacturing activity - machining, chipping, grinding, safety precautions in use of Boilers.
PRECAUTIONS IN PROCESSES: Precautions in processes and operations involving explosive, toxic substances, dusts, gases, vapour, clouds formation and combating, workplace exposure limit, control measures.
SAFETY IN THE ENGINEERING INDUSTRY: Introduction to machine operations & guarding, safety in the use of machines, safety precautions while using hand tools & power tools, selection, maintenance & care of hand and power tools.

Module 5: Transportation and storage of chemicals in industries

CHEMICAL COMPATIBILITY & TRANSPORTATION: Chemicals compatibility considerations, transportation of chemicals, toxic / flammable / explosive / radioactive substances by all modes - safety precautions, use of material Safety Data Sheets.
PERSONAL PROTECTIVE EQUIPMENT: Need for personal protection equipment, selection, use, care & maintenance of respiratory and non-respiratory personal protective equipment, non-respiratory protective devices, head protection, ear protection, face and eye protection, hand protection, foot protection, body protection.
BULK STORAGE: General considerations, types of storage, layout of storages with specific reference to LPG, CNG, chlorine, ammonia.
CHEMICALS ACCIDENT PREVENTION & MAJOR CASE STUDIES: Major industrial accidents due to chemicals (Bhopal gas tragedy) - emergency planning, major industrial disaster case studies.

Text Books

1. **Wills, G.L,** *Safety in Process Plant Design*, John Wiley and Sons

2. **Frank P. Less,** *Loss Prevention in Process Industries, Volume I and II,* Butterworth Heinemann, 1980.

Reference Books

1. **Crowl, D.A and Louvar, J.F,** *Chemical Process Safety: Fundamentals with Applications,* Prentice Hall, Inc.
2. **Pandey, C.G,** *Hazards in Chemical Units: a Study*, Oxford IBH Publishing Co., New Delhi.
3. **Fawcett H.H and Wood W.S,** *Safety and Accident Prevention in Chemical Operation,* 2 Ed, Wiley *Interscience, 1982.*
4. Industrial Safety and Laws*, 1993, by Indian School of Labour Education, Madras.*
5. **Raghavan K. V and Khan A A,** *Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.*
6. **Marshal V. C,** *Major Chemical Hazards, Ellis Horwood Ltd., Chichester, United Kingdom, 1987.*
7. *A Guide to Hazard Operability Studies, Chemical Industry Safety and Health Council of the Chemical Industries Association (London , 1977.*

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Hazard, Risk and Accident (10 hrs)**	
1.1	**HAZARD**: Introduction to hazard, causes, identification, evaluation & control of hazard. HAZOP analysis, Sources for information on hazard evaluation.	2
1.2	**OCCUPATIONAL HAZARDS & DANGEROUS CHEMICALS**: Introduction to occupational health hazards & dangerous properties of chemicals, dust, gases, fumes, mist, vapours, smoke and aerosols, concepts of threshold limit values, classification of hazards.	2
1.3	**RISK ANALYSIS**: Definition of risk, risk analysis, introduction to Failure Mode & Effect Analysis (FMEA), Fault Tree Analysis (FTA), and Event Tree Analysis (ETA).	2
1.4	**ACCIDENT**: Definition of accidents, classification of accidents, need for the analysis of accidents, methods adopted for reducing accidents, investigation of accidents, safety slogans, principles of accident(Heinrich theory), accident ratio study, identification of unsafe mechanical/ physical conditions, identification of unsafe acts. Frequency rate, prevention methods.	3
2	**Industrial Safety (10 hrs)**	
2.1	**SAFETY CONCEPT** : Introduction to safety management, safety policy, safety committee, safety review, responsibility of management, safety officers duties & responsibilities, safety targets, objectives, standards, practices and performances. Motivation & communication as part of a safety programme. Duties & responsibility of an owner, duties and responsibilities of a worker, role of a supervisor, role of a safety engineer.	2

2.2	**ILO CONVENTION**: Introduction of ILO and conventions. **FACTORIES ACT 1948 (Amended)**: Health - cleanliness, disposal of waste, ventilation and temperatures, dust & fumes, drinking water, lighting, latrines & urinals. safety - fencing of machineries, work on or near machinery in motion, hoists and lifts, pressure plants, floors, stairs and means of escape, protection against fumes & gases, safety offers. Welfare - washing facilities in dry clothing, storing, sitting, first aid appliances, canteen, and shelters for rest & lunch, crèches, welfare offers, rights & obligations of workers.	3
2.3	**PREPARATION & ASSESSMENT OF SAFETY AUDIT** : Introduction to safety checklist, plant safety inspection, safety precautions adopted in the plant, safety tag system, safety audit report objective of safety audit, type of audit, audit team, elements of safety audit, method of audit, audit steps, concept and layout of audit report.	2
2.4	**WELFARE & TRAINING**: General provision, drinking water, sanitary & washing, cloakrooms, facilities for food & drink, shelters & living accommodation, information & training.	2
3	**Fire Hazard (10 hrs)**	
3.1	**BASIC PHYSICS AND CHEMISTRY RELATED TO FIRE**: Definition of matter and energy, physical properties of matter like density, specific gravity, relative density, vapour density, melting & boiling point, flammable limits, latent heat, etc, effects of density on behaviour of gases, basics of oxidizing and reducing agents, acids. Flammable liquids -classification and types of tanks, dust and explosion, liquid and gas fires, LPG. UCVE, BLEVE, slope over, boil over, gas laws, P-V-T relation for perfect gas.	2
3.2	**ANATOMY OF FIRE**: Definition of combustion, elements of combustion, products of combustion, heat of reaction and calorific value, flash point, fire point, ignition temperature and spontaneous combustion. fire triangle, fire tetrahedron, fire pyramid, source of heat(chemical, mechanical, electrical, nuclear etc.), classification of fire and method of fire extinguishment, oxygen and its effects on combustion, mode of heat transfer(conduction, convection & radiation).	2
3.3	**CLASSIFICATION OF FIRE & EXTINGUISHERS**: Classification of fire and types of extinguishers, maintenance, method of operation, halon and its detrimental effect on environment. Alternatives of halon. Types of fire extinguishing agents, rating system for portable fire extinguishers, limitation of fire extinguishers, inspection requirement.	2
3.4	**HOSE & PUMPS, WATER TENDER**: fire service hose & hose fittings, fixed fire Fighting installations ropes & lines, practical firemanship, small & special gears, water tender. Types of fire hoses, its construction, caused by decay care & maintenance.	2

	Types of hose fittings, identification and use of hose fittings. Types of FFF installations -testing care & maintenance	
3.5	**HYDRANT, DETECTORS & LADDERS**: Introduction to hydrant & hydrant fittings, water supply requirements for fire fighting, introductions to pump & primers, detectors & ladders. **BREATHING SETS**: Classification and selection of respiratory personal protective devices, instruction & training in the use, maintenance and care of self containing breathing apparatus. **RESUSCITATION & FIRST AID**: Burns, fractures, toxic ingestion, bleeding, wounds and bandaging, artificial respiration, techniques of resuscitation.	2
4	**Electrical & Chemical safety (10 hrs)**	
4.1	**BASIC PHILOSOPHY OF SAFETY**: Peculiarities & parameters governing the safety in construction e.g. site planning, layout, safe access / egress. Construction Industry: General safety precautions related to construction industry, safety in the use of construction machinery. Industrial lighting: Introduction to lighting, ventilation, heat stress, cold Stress, noise & vibration.	2
4.2	**ELECTRICAL SAFETY**: Electrical hazards, static electricity. Identification and zoning of hazardous areas, classification of products. **EXCAVATIONS, DEMOLITIONS & STRUCTURAL FRAMES**: Safety related to excavation, demolitions, framework & concrete Work, pile driving and work over water.	2
4.3	**EXCAVATIONS, DEMOLITIONS & STRUCTURAL FRAMES**: Safety related to excavation, demolitions, framework & concrete Work, pile driving and work over water. **SAFETY IN MELTING, BOILERS**: Hazards in process of melting (furnaces), casting, and forging. Automatic manufacturing activity - machining, chipping, grinding, safety precautions in use of Boilers.	3
4.4	**PRECAUTIONS IN PROCESSES**: Precautions in processes and operations involving explosive, toxic substances, dusts, gases, vapour, clouds formation and combating, workplace exposure limit, control measures. **SAFETY IN THE ENGINEERING INDUSTRY**: Introduction to machine operations & guarding, safety in the use of machines, safety precautions while using hand tools & power tools, selection, maintenance & care of hand and power tools.	2
5	**Transportation and storage of chemicals in industries (8 hrs)**	
5.1	**CHEMICAL COMPATIBILITY & TRANSPORTATION**: Chemicals compatibility considerations, transportation of chemicals, toxic / flammable / explosive / radioactive substances by all modes - safety precautions, use of material Safety Data Sheets.	2

5.2	**PERSONAL PROTECTIVE EQUIPMENT**: Need for personal protection equipment, selection, use, care & maintenance of respiratory and non-respiratory personal protective equipment, non-respiratory protective devices, head protection, ear protection, face and eye protection, hand protection, foot protection, body protection.	2
5.3	**BULK STORAGE**: General considerations, types of storage, layout of storages with specific reference to LPG, CNG, chlorine, ammonia.	2
5.4	**CHEMICALS ACCIDENT PREVENTION & MAJOR CASE STUDIES**: Major industrial accidents due to chemicals (Bhopal gas tragedy) - emergency planning, major industrial disaster case studies.	2

SEMESTER -4
HONOURS

BTT292	CELL SIGNALLING	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Understand the process of cell signalling in normal physiological process and its variation during pathological processes

Prerequisite: A basic background in Biochemistry and cellular biology

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the components, principles and properties of major cell signaling pathways.
CO 2	Describe how cells exploit signaling components to assemble the specific signalingpathways, which they require to communicate which each other or to adapt to changes of external environment.
CO 3	Contemplate on the role of signaling pathways in control of gene expression (transcription and translation) and cellular metabolism.
CO 4	Clinical Significance of Cell signalling

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	2	-	-	-	-	-	2	-	2
CO 2	2	-	-	-	-	-	-	-	-	2	-	2
CO 3	-	3	-	2	-	-	-	-	-	2	-	2
CO 4	-	3	-	2	-	-	-	3	-	2	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Describe the role of integrins in cell communication?

2. How do second massagers play a role in cell signalling?

3. Describe the phosphorylation processes in G protein receptor?

Course Outcome 2 (CO2)

1. Describe the role of transcription factors in the JAK-STA pathway with two specific examples ?

2. Illustrate the activation of protein kinases in glycogen metabolism with a neat diagram?

3. How does ECM affect cell signalling? Illustrate this with one specific example?

Course Outcome 3(CO3):

1. Bring out the key transcription factors and its role in Wnt signalling?

2. Describe the RTK gene and the various domains in general?

3. MAP kinases and their signalling pathways are crucial in pathological conditions. Justify the statement

Course Outcome 4 (CO4):

1. Demonstrate the memory segmentation for x86 architecture.

2. Give an example for generating physical addresses for accessing data segments.

3. Describe the functionality of the pipeline mechanism in X86

Model Question paper

			Total Pages:
Reg No.:_______________		Name:__________________________	
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ____________ 20__			
Course Code: BTT 292			
Course Name: CELL SIGNALLING			
Max. Marks: 100			Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Interpret the reasons to have protein and membrane trafficking in cellular system
	b)	Define Apoptosis. Comment on the negative role it play in cellular system
	c)	Brief up the basic principles of cell signalling
	d)	Critically evaluate the concept integration and amplification of signals.
	e)	Draw conclusions to prove that response of GPCR is important to trigger the production of second messengers
	f)	Sketch and explain signal attenuation process
	g)	Comment on the impact of G protein effectors in protein signalling
	h)	Analyze signals with long term consequences with reference to proteases
	i)	Distinguish nuclear receptor cell cycle control system from other components in regulation giving reasons
	j)	Exemplify physiological roles giving attention to cardiovascular diseases

PART B

Answer any one full question from each module. Each carries 14 marks.			
2	a)	Discuss in detail the cytoskeletal organization and dynamics	(14)
		OR	
3		Define cell cycle. Detail the stages in cell cycle with the aid of a neat and labelled diagram	(14)
4	a)	Characterize and analyse the components of signalling	(8)
	b)	Signify the components giving reasons wherever necessary	(6)
		OR	
5	a)	Classify membrane receptors	(8)
	b)	Appraise the functions and importance of receptors in cellular system	(6)
6		Correlate *Ras* to MAPK pathways. Add a note on its importance	(14)
		OR	
7		Relate growth factor/RTS and *Wnt*receptors in cellular system	(14)
8		Detail signal transduction process through Ion channels	(14)
		OR	
9		Critically evaluate the structure and functions of GPCR's in protein signalling	(14)
10		Define Chromatin. Examine chromatin remodelling as a essential component in regulation	(14)
		OR	
11		Outline the topic signalling defects. Relate it to human diseases with examples	(14)
****			

Syllabus

Module 1

Introduction to Advanced cell biology: Protein targeting and membrane trafficking.Cytoskeletal organization and dynamics. Cell adhesion and extracellular matrix, Cell division cycle, Cell cycle and death

Module 2

Signalling pathways in prokaryotes.Two-component system (TCS).Evolution and TCS in eukaryotes.Basic principles of cell signalling. Characterization of signalling components: signalling molecules, receptors, second messengers, effectors, signalling complexes. Integration and amplification of signals.Basic classification and characterization of membrane receptors.

Module 3

Principles of Cell SignalingSystems : General Introduction and Introduction to G Protein-Coupled Receptor (GPCR) Signaling. Growth Factor/ Receptor Tyrosine Kinases (RTKs) and Wnt Receptors.Ras to Mitogen-Activated Protein Kinase (MAPK) Pathways.Protein Kinases.Protein Phosphatases. Domains in RTKs: Structural Aspects

Module 4

G Protein Signaling: Structure of GPCRs, G proteins, and GTPases, GPCRs and Their Modulation, G Protein Effectors. **Signal Transduction Through Ion Channels:** Ligand-Gated Channels, Regulation of Ion Channels by G Proteins, Transient Receptor Protein (TRP) Channels. **Signals with Long-Term Consequences:** Proteases and Signaling, Apoptosis, Cytokine Receptors

Module 5

Regulation of Transcription and Translation: Nuclear Transactivators and Repressors, Chromatin Remodeling , Nuclear Receptors Cell cycle control. Signalling defects.

Examples of physiological roles (apoptosis, cell cycle regulation, gene transcription) and clinical significance (cancer, cardiovascular disease, learning and memory, immune responses).

Text Books

1. Cell Biology by Rastogi : New Age international Publishers
2. Textbook of Cell Signalling in Cancer by Jacques Robert :Springer

Reference Books

1. 1. Molecular and Cellular Signaling. Beckerman , MUSA: Springer

2. Molecular Biology of the Cell; Alberts et al,

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Advanced cell biology:**	
1.1	Protein targeting and membrane trafficking.	2
1.2	Cytoskeletal organization and dynamics.	3
1.3	Cell adhesion and extracellular matrix, Cell division cycle, Cell cycle and death	3
2	**Signalling pathways in prokaryotes**	
2.1	Two-component system (TCS). Evolution and TCS in eukaryotes. Basic principles of cell signalling.	3
2.2	Characterization of signalling components: signalling molecules, receptors, second messengers, effectors, signalling complexes. Integration and amplification of signals.	3
2.3	Basic classification and characterization of membrane receptors.	3
3	**Principles of Cell Signalling Systems** :	
3.1	General Introduction and Introduction to G Protein-Coupled Receptor (GPCR) Signalling.	3
3.2	Growth Factor/ Receptor Tyrosine Kinases (RTKs) and Wnt Receptors.	3
3.3	Ras to Mitogen-Activated Protein Kinase (MAPK) Pathways. Protein Kinases. Protein Phosphatases.	3
3.4	Domains in RTKs: Structural Aspects	3
4	**G Protein Signalling**:	
4.1	Structure of GPCRs, G proteins, and GTPases, GPCRs and Their Modulation, G Protein Effectors.	3
4.2	**Signal Transduction Through Ion Channels:** Ligand-Gated Channels, Regulation of Ion Channels by G Proteins, Transient Receptor Protein (TRP) Channels.	3
4.3	**Signals with Long-Term Consequences:** Proteases and Signalling, Apoptosis, Cytokine Receptors	3
5	**Regulation of Transcription and Translation:**	
5.1	Nuclear Transactivators and Repressors, Chromatin Remodelling,	3

	Nuclear Receptors Cell cycle control. Signalling defects.	
5.2	Examples of physiological roles (apoptosis, cell cycle regulation, gene transcription)	2
5.3	Clinical significance (cancer, cardiovascular disease, learning and memory, immune responses).	2

BTT294	BIORESOURCE TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Understand the various sources of bioenergy and conversions to a useful form

Prerequisite: Knowledge in Basic Sciences

Course Outcomes: After the completion of the course the student will be able to

CO 1	Disseminate and inculcate knowledge in all the related areas of bioenergy, biotransformation and bio resource systems and technologies associated with conversion or production.
CO 2	Analysis of leading scientific topics for sustainable living based on waste management system.
CO 3	Judge biological mechanisms laying out the fundamental knowledge to undertake better and more efficient scientific and technological advancements in the field of bio resource technology and engineering.
CO 4	Appraise the theoretical aspects of Bio resource technology

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	2	2	-	-	2	-	-	-	-	1
CO 2	-	-	3	2	-	2	1	2	2	-	-	-
CO 3	-	1	2	2	-	-	2	2	2	-	-	-
CO 4	-	1	3	2	-	-	1	-	-	-	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

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Course Level Assessment Questions

Course Outcome 1 (CO1):

1. State the uses of cellulosic waste for bioconversion.
2. List the feed stock materials used for biogas production.
3. Elaborate the process of enzymatic deinking.

Course Outcome 2 (CO2)

1. Justify the role of microbes in bioethanol production.
2. Exemplify the significance of renewable energy
3. Recall the oxygen sensitivity problems in hydrogenases during biohydrogen production.

Course Outcome 3(CO3):

1. Demonstrate the mechanism of transesterification.
2. List out the factors affecting methane formation
3. Describe the advantages of microbial ethanol production

Course Outcome 4 (CO4):

1. Demonstrate the role of various oils in biofuel production.
2. Give example for pre-treatment technologies used in bioconversion.
3. Describe the role of microbes in biofuel production.

Model Question paper

		Total Pages:
Reg No.:______________		Name:_______________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
Course Code: BTT 294		
Course Name: BIORESOURCE TECHNOLOGY		
Max. Marks: 100		Duration: 3 Hours

		PART A
		Answer all questions, each carries 3 marks.
1	a)	What are the different sources of renewable energy sources?
	b)	Explain the significance of cellulosic materials.
	c)	Explain the role of chemically reacting lipids in biodiesel production.
	d)	What are the factors affecting methane formation?
	e)	List out the applications of biodiesel
	f)	Name three microorganisms used for bioethanol production.
	g)	Give a note on Butanol fuel mixtures
	h)	Which are the common feedstock materials used in biogas production?
	i)	Give a note on autohydrolysis.

	j)	Brief about cellulose saccharification.	
PART B			
Answer any one full question from each module. Each carries 14 marks.			
2		Explain bioethanol and biopropanol production.	(14)
		OR	
3	a)	What are the methods employed for ethanol recovery?	(7)
	b)	Explain Octane rating and air fuel ratio.	(7)
4		Explain in detail about different extraction techniques used to separate oil from algae for biodiesel production.	(14)
		OR	
5	a)	What are the different constraints in Biodiesel production?	(7)
	b)	Explain the applications of biodiesel in terms of environmental benefits and concerns?	(7)
6		Explain the bioconversion of lignocellulosic material to value added products using an appropriate flow diagram.	(14)
		OR	
7	a)	What are the different types of feedstocks for the production of biofuel? Explain.	(8)
	b)	Exemplify fuel-related advanced carbon materials and by-products.	(6)
8		With the help of a neat diagram explain in detail the design of a biogas plant. Critically examine the role of microbes in biogas production	(14)
		OR	
9	a)	Explain the factors affecting methane production.	(7)
	b)	Brief about the oxygen sensitivity problems in hydrogenases during biohydrogen production.	(7)
10		Explain the significance of renewable energy.	(14)
		OR	
11	a)	Exemplify the term bioenergy crops.	(7)

	b)	What do you mean by feed stocks? Explain their significance	(7)
****			

Syllabus

Module 1

RENEWABLE ENERGY SOURCE

Hydropower, geothermal power, solar power, wind power. Value added chemicals and production of Biofuel -Biomass - Feed stocks (agricultural crops, bioenergy crops, agricultural waste residues, wood residues, waste stream)

Module 2

FUEL TECHNOLOGY AND BIOCONVERSION

History - Definition of biofuel, applications of Biofuel. Scientific and technological aspects of converting fossil and renewable resources to clean fuels.*Fuel*-related advanced carbon materials and by-products. Significance of Lignocellulosic and cellulosic waste for Bioconversion.Bioconversion of lignocellulosics, cellulose saccharification, pre-treatment technologies (air separation process, mechanical size reduction, autohydrolysis) - Pulping and bleaching – Enzymatic deinking.

Module 3

BIOGAS

Biogas-definition, Biogas plant, feedstock materials, organic matter, such as food scraps and animal waste for biogas production, factors affecting methane formation - Role of microbes – Biohydrogen production - Oxygen sensitivity problems in hydrogenases

Module 4

BIO ETHANOL AND BUTANOL

Role of microbes in Bioethanol and Butanol production, Advantages of ethanol through microbial and enzymatic process, production of ethanol from cellulosic materials, ethanol recovery - Biobutanol production, energy content and effects on fuel economy - Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization -Butanol fuel mixtures

Module 5

BIODIESEL

Biodiesel definition,Transesterification, Production of biodiesel, Constraints in Biodiesel production and use.Role of chemically reacting lipids (e.g., vegetable oil, soybean oil, animal fat in Biodiesel production.Role of Algae in Biodiesel production, oil extraction from algae by chemical solvents, enzymatic, expeller press - Osmotic shock and ultrasonic assisted extraction - Applications of biodiesel, environmental benefits and concerns.

Text Books

1. Alain A.V., Biomass to biofuels strategies for global Industries, John Wiley &sons ltd, 1st Edition, 2010.
2. Twidell., J & Weir., T., Renewable energy resources, Taylor & Francis 2nd Edition, 2006.

Reference Books

1. Luque, R., Camp, J., Hand book of biofuel production processes and technologies, Woodhead publishing ltd., 1st Edition, 2011.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**RENEWABLE ENERGY SOURCE**	
1.1	Hydropower, geothermal power, solar power, wind power	2
1.2	Value added chemicals and production of biofuel, biomass	2
1.3	Feed stocks -agricultural crops, bioenergy crops	3
1.4	Feed stocks- agricultural waste residues, wood residues, waste stream	2
2	**FUEL TECHNOLOGY AND BIOCONVERSION**	
2.1	History - Definition of biofuel, applications of Biofuel. Scientific and technological aspects of converting fossil and renewable resources to clean fuels.	2
2.2	*Fuel*-related advanced carbon materials and by-products.	1
2.3	Significance of Lignocellulosic and cellulosic waste for Bioconversion. Bioconversion of lignocellulosics, cellulose saccharification	2
2.4	Pre-treatment technologies - air separation process, mechanical size reduction, autohydrolysis.	2
2.5	Pulping and bleaching – Enzymatic deinking.	2

3	**BIOGAS**	
3.1	Biogas-definition, Biogas plant, feedstock materials, organic matter, such as food scraps and animal waste for biogas production	3
3.2	factors affecting methane formation, Role of microbes	2
3.3	Biohydrogen production	3
3.4	Oxygen sensitivity problems in hydrogenases	2
4	**BIO ETHANOL AND BUTANOL**	
4.1	Role of microbes in Bioethanol and Butanol production, Advantages of ethanol through microbial and enzymatic process,	2
4.2	Production of ethanol from cellulosic materials, ethanol recovery	2
4.3	Biobutanol production, energy content and effects on fuel economy	3
4.4	Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization -Butanol fuel mixtures	2
5	**BIODIESEL**	
5.1	Biodieseldefinition, Transesterification, Production of biodiesel, Constraints in Biodiesel production and use.	2
5.2	Role of chemically reacting lipids (e.g., vegetable oil, soybean oil, animal fat in Biodiesel production. Role of Algae in Biodiesel production	2
5.3	Oil extraction from algae by chemical solvents, enzymatic, expeller press - Osmotic shock and ultrasonic assisted extraction	2
5.4	Applications of biodiesel, environmental benefits and concerns.	2

BTT 296	BIOPROCESS INSTRUMENTATION	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: An advanced knowledge in process instrumentations and applications

Prerequisite: Knowledge on Bioprocess Calculations

Course Outcomes: After the completion of the course the student will be able to

CO 1	Outline the various elements and characteristics of measuring instruments
CO 2	Explain the working principle of various industrial instruments.
CO 3	Explain various types of biosensors for measurement.
CO 4	Select suitable instruments for measuring process variables.
CO 5	Explain the working principle of analytical instruments.
CO 6	Understand the application of digital computers in fermentation processes and data analysis

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	1	-	-	-	-	-	-	-	-	-	2
CO 2	2	-	-	2	-	-	-	-	-	-	-	-
CO 3	2	-	-	2	-	-	-	-	-	-	-	-
CO 4	3	-	3	-	-	-	-	-	-	-	-	-
CO 5	3	-	-	3	-	-	-	-	-	-	-	-
CO 6	3	2	-	2	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Outline the various elements and characteristics of measuring instruments

1. Differentiate between secondary and manipulating elements?
2. Name any two piezoelectric materials used in piezoelectric transducer
3. Discuss the static and dynamics characteristics of measuring instruments

Course Outcome 2 (CO2) : Explain the working principle of various industrial instruments

1. Explain the principle behind the working of Knudsen gauge.
2. Name any two types of positive displacement flow meters
3. List any four biomedical applications of transducers with example.

Course Outcome 3(CO3): Explain various types of biosensors for measurement

1. Explain the basic principle and components of a biosensor.
2. State the role of BOD biosensor in environmental biotechnology
3. Discuss about the on-line sensors for cell properties

Course Outcome 4 (CO4): Select suitable instruments for measuring process variables

1. Discuss the working principle behind manometers.
2. Elaborate the static and dynamics characteristics of measuring instruments

3. Explain the principle of resistance thermometer

Course Outcome 5 (CO5): Explain the working principle of analytical instruments.

1. Comment on the working principle of electrophoretic technique.
2. With a neat sketch, illustrate the working of gas chromatography.
3. Illustrate the instrumentation and working of HPLC with a neat diagram.

Course Outcome 6 (CO6): Understand the application of digital computers in fermentation processes and data analysis

1. List some strategies used for programmed batch bioreaction
2. Discuss data smoothing and interpolation with an example
3. Explain in detail on various elements of digital computers

Model Question paper

			Total Pages:
Reg No.:_______________		Name:_________________________ _	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 296

Course Name: BIOPROCESS INSTRUMENTATION

Max. Marks: 100 | Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Differentiate between secondary and manipulating elements?
	b)	Name any three piezoelectric materials used in piezoelectric transducer
	c)	Explain the importance of P& I diagrams
	d)	List any three flow measuring devices
	e)	Concisely explain any two detectors used in gas chromatography?
	f)	Define isotachophoresis
	g)	State the role of BOD biosensor in environmental biotechnology.
	h	List any three biomedical applications of transducers with example

	)	
	i)	Discuss Fermentation software system
	j)	List out various elements of digital computers

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Elaborate the static and dynamics characteristics of measuring instruments	(14)
		OR	
3		Explain the different types of transducers in bioprocess applications	(14)
4	a)	Detail the working of head flow meters.	(7)
	b)	Discuss the working principle behind manometers.	(7)
		OR	
5	a)	What are the precautions to be taken in temperature measuring instruments	(4)
	b)	Explain the principle and working of any two types of temperature measuring instruments with neat sketch	(10)
6	a)	With a neat sketch, illustrate the working of gas chromatography.	(10)
	b)	Differentiate stationary phase and mobile phase with an example?	(4)
		OR	
7	a)	Illustrate the instrumentation and working of HPLC with a neat diagram.	(10)
	b)	Explain the Principle of NMR	(4)
8	a)	With a neat sketch, explain different components of a biosensor.	(7)
	b)	Discuss about the on-line sensors for cell properties	(7)
		OR	
9		Describe any two off line sensors for cell properties with neat sketch	(14)
10	a)	List some strategies used for programmed batch bioreaction.	(7)
	b)	Explain in detail on various elements of digital computers	(7)
		OR	
11	a)	Discuss data smoothing and interpolation with an example	(7)
	b)	Elaborate state and parameter estimation.	(7)

****

Syllabus

Module 1

Principles of measurement. Error Analysis, Classification, methods of measurements - Direct and indirect measurements, various elements in a measuring instrument , Static and dynamic characteristics of measuring instrument, accuracy, reproducibility, sensitivity, static error, dead zone, dynamic error, fidelity lag, speed of response etc.
Different types of sensors and transducers in bioprocess applications– their classification, principle and working, Recording, indicating and signaling instruments, Transmission methods.

Module 2

Instruments for measuring process variables: Temperature measurement: Filled system Thermometer, Thermocouples- ranges of different types of temperature measuring instruments, resistance thermometers, radiation and optical pyrometers. Sources of errors and precautions to be taken in temperature measurements
Pressure measurement: Principles of working of manometers, various types of manometers - McLeod gauge, Knudsen gauge, Bourdon gauge, bellows, diaphragm, electrical pressure transducers piezoelectric manometers, thermal conductivity gauges- ionisation gauge high pressure measuring instrument
Flow measurement: Head flow meters, area flow meters, positive displacement flow meters, mass and magnetic flow meters and strain gauges. A brief overview of P and I diagrams.
Level measurement: Direct and inferential type.
Miscellaneous measurement: Measurement of density and specific gravity, humidity, viscosity and composition.

Module 3

Monitoring of bioprocess: different types of fermentation-common measurements and control systems, additional sensors, redox, airflow, weight, pressure.Online data analysis for measurement of important physico-chemical and biochemical parameters.
Analytical instruments: Chromatography: GC, HPLC, Spectroscopy: Mass spectroscopy, NMR, autoradiography, Electrophoresis, schematic summary of biochemical reactor instrumentation

Module 4

Biosensors: Various components of biosensors - On-line sensors for cell properties - off-line analytical methods - potentiometric biosensors - Transducers, calorimetric, optical, potentiometric/amperometric, conductometric/resistometric biosensors, Biosensors for glucose, alcohol, carbon dioxide, cell population, BOD

Module 5

Elements of Digital computers; Computer Interfaces and peripheral devices-Data Analysis-Data smoothing and interpolation- State and parameter estimation. Components of a computer linked system-Programmed batch bioreactor-Design and operation strategies for batch plants-Fermentation software system

Text Books

1. Eckman D P, *Industrial Instrumentation*, Wiley Eastern Ltd (1975).
2. Patranabis, Principles of industrial Instrumentation, Tata McGraw Hill
3. Shuler M. L. and Kargi F, Bioprocess Engineering, 2nd Edition, Prentice Hall of India, New Delhi. 2002.
4. Bailey J.E and Ollis D.F, Biochemical Engineering Fundamentals, 2nd Ed., McGraw-Hill Publishing Co.

Reference Books

1. Stanbury P, Whitakar A and Hall S.J, Principles of Fermentation Technology 2nd Ed., Elsevier Pergamon Press, 1999.
2. T.K.Ghose (Ed.) Process Computations in Biotechnology (1994), Tata McGraw Hill.
3. A.Fischer (Ed.), Advances in Biochemical Engineering, Vol. 13, 1973,Springer Verlag, Germany
4. Aiba, Humphry and Millis, Biochemical Engineering , 2nd Ed., (1973),Academic press
5. McNeil and Harvey, Fermentation - A Practical Approach (1990). IRL Press, U.K.
6. Scragg, Bioreactors in Biotechnology - A Practical Approach (1991), Ellis Horwood Ltd., U.K.
7. Kerk F W, Rimboi W, and Tarapore R, Instrumentation, Wiley and Sons, 1983.
8. Considine D N, Process Instruments and Controls Handbook, McGraw Hill, 2001.
9. Andrew W G, Applied instrumentation in the Process Industries Vols I,II,III Gulf Publishing Company, 1987.
10. Ashok Mulchandani and Kim R. Rogers, Enzyme and Microbial Biosensors: Techniques and Protocols- (Eds); Humana Press, Totowa, NJ, 1998.

11. Ashok Mulchandani and Kim R. Rogers, (Eds).;Affinity Biosensors: Techniques and Protocols, Humana Press, Totowa, NJ, 1998.

12. Yang, V.C. and T.T. Ngo, Biosensors and Their Applications, Kluwer Academic/Plenum Publishers, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Principles of measurement.**	
1.1	Error Analysis, Classification, methods of measurements - Direct and indirect measurements,	2
1.2	various elements in a measuring instrument ,	1
1.3	Static and dynamic characteristics of measuring instrument, accuracy, reproducibility, sensitivity, static error, dead zone, dynamic error, fidelity lag, speed of response etc.	2
1.4	Different types of sensors in bioprocess applications– their classification, principle and working,	2
1.5	Different types of transducers in bioprocess applications– their classification, principle and working,	1
1.6	Recording instruments	1
1.7	indicating and signaling instruments, Transmission methods.	1
2	**Instruments for measuring process variables:**	
2.1	Temperature measurement: Filled system Thermometer, Thermocouples- ranges of different types of temperature measuring instruments,	1
2.2	resistance thermometers, radiation and optical pyrometers.	1
2.3	Sources of errors and precautions to be taken in temperature measurements	1
2.4	Pressure measurement: Principles of working of manometers,	1
2.5	various types of manometers - McLeod gauge, Knudsen gauge, Bourdon gauge,	1
2.6	bellows, diaphragm, electrical pressure transducers piezoelectric manometers	1
2.7	thermal conductivity gauges- ionisation gauge high pressure measuring instrument	1
2.8	Flow measurement: Head flow meters, area flow meters,	1
2.9	Positive displacement flow meters, mass and magnetic flow meters and strain gauges.	1
2.10	A brief overview of P and I diagrams.	1
2.11	Level measurement: Direct and inferential type.	1
2.12	Miscellaneous measurement: Measurement of density and specific gravity	1

2.13	humidity, viscosity and composition	1
3	**Monitoring of bioprocess:**	
3.1	Different types of fermentation-common measurements and control systems, additional sensors, redox, airflow, weight, pressure.	1
3.2	Online data analysis for measurement of important physico-chemical and biochemical parameters.	1
3.3	Chromatography: GC,	1
3.4	HPLC	1
3.5	Spectroscopy: Mass spectroscopy,	1
3.6	NMR,	1
3.7	autoradiography,	1
3.8	Electrophoresis	1
3.9	schematic summary of biochemical reactor instrumentation	1
4	**Biosensors**:	
4.1	Various components of biosensors	1
4.2	On-line sensors for cell properties	1
4.3	off-line analytical methods - potentiometric biosensors -	1
4.4	Transducers, calorimetric biosensors	1
4.5	optical, potentiometric/amperometric biosensors	1
4.6	conductometric/resistometric biosensors	1
4.7	Biosensors for glucose, alcohol,	1
4.8	Biosensors carbon dioxide, cell population, BOD	1
5	**Elements of Digital computers;**	
5.1	Computer Interfaces and peripheral devices	1
5.2	Data Analysis-Data smoothing and interpolation- State and parameter estimation.	1
5.3	Components of a computer linked system-	1
5.4	Programmed batch bioreactor-Design and operation strategies for batch plants	1
5.5	Fermentation software system	1

SEMESTER -3

COMMON COURSES S3 & S4

CODE MCN201	SUSTAINABLE ENGINEERING	CATEGORY	L	T	P	CREDIT
			2	0	0	NIL

Preamble: Objective of this course is to inculcate in students an awareness of environmental issues and the global initiatives towards attaining sustainability. The student should realize the potential of technology in bringing in sustainable practices.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this direction
CO 2	Explain the different types of environmental pollution problems and their sustainable solutions
CO 3	Discuss the environmental regulations and standards
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1						2	3					2
CO 2						2	3					2
CO 3						2	3					2
CO 4						2	3					2
CO 5						2	3					2

Assessment Pattern

Mark distribution

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the relevance and the concept of sustainability and the global initiatives in this direction

1. Explain with an example a technology that has contributed positively to sustainable development.
2. Write a note on Millennium Development Goals.

Course Outcome 2 (CO2): Explain the different types of environmental pollution problems and their sustainable solutions

1. Explain the 3R concept in solid waste management?
2. Write a note on any one environmental pollution problem and suggest a sustainable solution.
3. In the absence of green house effect the surface temperature of earth would not have been suitable for survival of life on earth. Comment on this statement.

Course Outcome 3(CO3): Discuss the environmental regulations and standards

1. Illustrate Life Cycle Analysis with an example of your choice.
2. "Nature is the most successful designer and the most brilliant engineer that has ever evolved". Discuss.

Course Outcome 4 (CO4): Outline the concepts related to conventional and non-conventional energy

1. Suggest a sustainable system to generate hot water in a residential building in tropical climate.
2. Enumerate the impacts of biomass energy on the environment.

Course Outcome 5 (CO5): Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles

1. Suggest suitable measures to make the conveyance facilities used by your institution sustainable.

Model Question paper

Part A

(Answer all questions. Each question carries 3 marks each)

1. Define sustainable development.
2. Write a short note on Millennium Development Goals.
3. Describe carbon credit.
4. Give an account of climate change and its effect on environment.
5. Describe biomimicry? Give two examples.
6. Explain the basic concept of Life Cycle Assessment.
7. Name three renewable energy sources.

8. Mention some of the disadvantages of wind energy.

9. Enlist some of the features of sustainable habitat.

10. Explain green engineering.

Part B

(Answer one question from each module. Each question carries 14 marks)

11. Discuss the evolution of the concept of sustainability. Comment on its relevance in the modern world.

OR

12. Explain Clean Development Mechanism.

13. Explain the common sources of water pollution and its harmful effects.

OR

14. Give an account of solid waste management in cities.

15. Explain the different steps involved in the conduct of Environmental Impact Assessment.

OR

16. Suggest some methods to create public awareness on environmental issues.

17. Comment on the statement, “Almost all energy that man uses comes from the Sun”.

OR

18. Write notes on:

    a. Land degradation due to water logging.

    b. Over exploitation of water.

19. Discuss the elements related to sustainable urbanisation.

OR

20. Discuss any three methods by which you can increase energy efficiency in buildings.

Syllabus

Sustainability- need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, Zero waste concept. Life Cycle Analysis, Environmental Impact Assessment studies, Sustainable habitat, Green buildings, green materials, Energy, Conventional and renewable sources, Sustainable urbanization, Industrial Ecology.

Module 1

Sustainability: Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

Module 2

Environmental Pollution: Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

Module 4

Resources and its utilisation: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

Module 5

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

Reference Books

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006
4. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
6. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
7. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
8. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Sustainability	
1.1	Introduction, concept, evolution of the concept	1
1.2	Social, environmental and economic sustainability concepts	1
1.3	Sustainable development, Nexus between Technology and Sustainable development	1
1.4	Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs)	1
1.5	Clean Development Mechanism (CDM)	1
2	Environmental Pollution	
2.1	Air Pollution and its effects	1
2.2	Water pollution and its sources	1
2.3	Zero waste concept and 3 R concepts in solid waste management	1
2.4	Greenhouse effect, Global warming, Climate change, Ozone layer depletion	1
2.5	Carbon credits, carbon trading and carbon foot print.	1
2.6	Legal provisions for environmental protection.	1
3	Environmental management standards	
3.1	Environmental management standards	1
3.2	ISO 14001:2015 frame work and benefits	1
3.3	Scope and Goal of Life Cycle Analysis (LCA)	1
3.4	Circular economy, Bio-mimicking	1
3.5	Environment Impact Assessment (EIA)	1
3.6	Industrial Ecology, Industrial Symbiosis	1
4	Resources and its utilisation	
4.1	Basic concepts of Conventional and non-conventional energy	1
4.2	General idea about solar energy, Fuel cells	1
4.3	Wind energy, Small hydro plants, bio-fuels	1
4.4	Energy derived from oceans and Geothermal energy	1
5	Sustainability Practices	
5.1	Basic concept of sustainable habitat	1
5.2	Methods for increasing energy efficiency of buildings	1
5.3	Green Engineering	1
5.4	Sustainable Urbanisation, Sustainable cities, Sustainable transport	1

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
			2	0	0	2
EST 200	DESIGN AND ENGINEERING					

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.
Part A : 30 marks
part B : 70 marks
Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks

Use only hand sketches

(1)Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6)Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12)Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13)Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14)Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16)Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18)Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19)Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20)Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.

2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5

3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361

4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
	First Series Examination	
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
	Second Series Examination	

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	**Professional Ethics**	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:______________**

PAGES:3 **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 200

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue-Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment-Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism- A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights-Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.

2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

SEMESTER -4

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
MCN202	CONSTITUTION OF INDIA		2	0	0	NIL

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Explain the background of the present constitution of India and features.
CO 2	Utilize the fundamental rights and duties.
CO 3	Understand the working of the union executive, parliament and judiciary.
CO 4	Understand the working of the state executive, legislature and judiciary.
CO 5	Utilize the special provisions and statutory institutions.
CO 6	Show national and patriotic spirit as responsible citizens of the country

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1						2	2	2		2		
CO 2						3	3	3		3		
CO 3						3	2	3		3		
CO 4						3	2	3		3		
CO 5						3	2	3		3		
CO 6						3	3	3		2		

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			

Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1 Discuss the historical background of the Indian constitution.

2 Explain the salient features of the Indian constitution.

3 Discuss the importance of preamble in the implementation of constitution.

Course Outcome 2 (CO2)

1 What are fundamental rights ? Examine each of them.

2 Examine the scope of freedom of speech and expression underlying the constitution.

3 The thumb impression of an accused is taken by the police against his will. He contends that this is a violation of his rights under Art 20(3) of the constitution. Decide.

Course Outcome 3(CO3):

1 Explain the powers of the President to suspend the fundamental rights during emergency.

2 Explain the salient features of appeal by special leave.

3. List the constitutional powers of President.

Course Outcome 4 (CO4):

1 Discuss the constitutional powers of Governor.

2 Examine the writ jurisdiction of High court.

3 Discuss the qualification and disqualification of membership of state legislature.

Course Outcome 5 (CO5):

1 Discuss the duties and powers of comptroller of auditor general.

2 Discuss the proclamation of emergency.

3 A state levies tax on motor vehicles used in the state, for the purpose of maintaining roads in the state. X challenges the levy of the tax on the ground that it violates the freedom of interstate commerce guaranteed under Art 301. Decide.

Course Outcome 6 (CO6):

1 Explain the advantages of citizenship.

2 List the important principles contained in the directive principles of state policy.

3 Discuss the various aspects contained in the preamble of the constitution

Model Question paper

PART A

(Answer all questions. Each question carries 3 marks)

1 Define and explain the term constitution.

2 Explain the need and importance of Preamble.

3 What is directive principle of state policy?

4 Define the State.

5 List the functions of Attorney general of India.

6 Explain the review power of Supreme court.

7 List the qualifications of Governor.

8 Explain the term and removal of Judges in High court.

9 Explain the powers of public service commission.

10 List three types of emergency under Indian constitution.

(10X3=30marks)

PART B

(Answer on question from each module. Each question carries 14 marks)

Module 1

11 Discuss the various methods of acquiring Indian citizenship.

12 Examine the salient features of the Indian constitution.

Module 2

13 A high court passes a judgement against X. X desires to file a writ petition in the supreme court under Art32, on the ground that the judgement violates his fundamental rights. Advise him whether he can do so.

14 What is meant by directive principles of State policy? List the directives.

Module3

15 Describe the procedure of election and removal of the President of India.

16 Supreme court may in its discretion grant special leave to appeal. Examine the situation.

Module 4

17 Discuss the powers of Governor.

18 X filed a writ petition under Art 226 which was dismissed. Subsequently, he filed a writ petition under Art 32 of the constitution, seeking the same remedy. The Government argued that the writ petition should be dismissed, on the ground of res judicata. Decide.

Module 5

19 Examine the scope of the financial relations between the union and the states.

20 Discuss the effects of proclamation of emergency.

(14X5=70marks)

Syllabus

Module 1 Definition, historical back ground, features, preamble, territory, citizenship.

Module 2 State, fundamental rights, directive principles, duties.

Module 3 The machinery of the union government.

Module 4 Government machinery in the states

Module 5 The federal system, Statutory Institutions, miscellaneous provisions.

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 24e, 2019

2 PM Bhakshi, The constitution of India, Universal Law, 14e, 2017

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, 2019.

2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad, 51e, 2019

3 MV Pylee, India's Constitution, S Chand and company, New Delhi, 16e, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1**	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory.	1
1.3	Meaning of citizenship, types, termination of citizenship.	2
2	**Module 2**	
2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2

2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences.	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	**Module 3**	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	**Module 4**	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction.	1
5	**Module 5**	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission.	1
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

CODE	COURSE NAME	CATEGORY	L	T	P	CREDIT
EST 200	DESIGN AND ENGINEERING		2	0	0	2

Preamble:

The purpose of this course is to

i) introduce the undergraduate engineering studentsthe fundamental principles of design engineering,

ii) make them understand the steps involved in the design process and

iii) familiarize them with the basic tools used and approaches in design.

Students are expected to apply design thinking in learning as well as while practicing engineering, which is very important and relevant for today. Case studies from various practical situations will help the students realize that design is not only concerned about the function but also many other factors like customer requirements, economics, reliability, etc. along with a variety of life cycle issues.

The course will help students to consider aesthetics, ergonomics and sustainability factors in designs and also to practice professional ethics while designing.

Prerequisite:

Nil. The course will be generic to all engineering disciplines and will not require specialized preparation or prerequisites in any of the individual engineering disciplines.

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the different concepts and principles involved in design engineering.
CO 2	Apply design thinking while learning and practicing engineering.
CO 3	Develop innovative, reliable, sustainable and economically viable designs incorporating knowledge in engineering.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	1					1			1		
CO 2		2				1		1				2
CO 3			2			1	1		2	2		1

Assessment Pattern

Continuous Internal Evaluation (CIE) Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination (ESE) Pattern: There will be two parts; Part A and Part B.
Part A : 30 marks
part B : 70 marks
Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions.
Part B contains 2 case study questions from each module of which student should answer any one. Each question carry 14 marks and can have maximum 2 sub questions.

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	5	5	10
Understand	10	10	20
Apply	35	35	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the different concepts and principles involved in design engineering.

1. State how engineering design is different from other kinds of design

2. List the different stages in a design process.

3. Describedesign thinking.

4. State the function of prototyping and proofing in engineering design.

5. Write notes on the following concepts in connection with design engineering 1) Modular Design, 2) Life Cycle Design , 3) Value Engineering, 4) Concurrent Engineering, and 5) Reverse Engineering

6. State design rights.

Course Outcome 2 (CO2) Apply design thinking while learning and practicing engineering.

1. Construct the iterative process for design thinking in developing simple products like a pen, umbrella, bag, etc.

2. Show with an example how divergent-convergent thinking helps in generating alternative designs and then how to narrow down to the best design.

3. Describe how a problem-based learning helps in creating better design engineering solutions.

4. Discuss as an engineer, how ethics play a decisive role in your designs

Course Outcome 3(CO3): Develop innovative, reliable, sustainable and economically viable designs incorporating different segments of knowledge in engineering.

1. Illustratethe development of any simple product by passing through the different stages of design process

2. Show thegraphical design communication with the help of detailed 2D or 3D drawings for any simple product.

3. Describe how to develop new designs for simple products through bio-mimicry.

Model Question paper

Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: EST 200

Course Name: DESIGN AND ENGINEERING

Max. Marks: 100Duration: 3 Hours

PART A

Answer all questions, each question carries 3 marks
Use only hand sketches

(1)Write aboutthe basic design process.

(2) Describe how to finalize the design objectives.

(3) State the role of divergent-convergent questioning in design thinking.

(4) Discuss how to perform design thinking in a team managing the conflicts.

(5) Show how engineering sketches and drawings convey designs.

(6)Explain the role of mathematics and physics in design engineering process.

(7) Distinguish between project-based learning and problem-based learning in design engineering.

(8) Describe how concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?

(9) Show how designs are varied based on the aspects of production methods, life span, reliability and environment?

(10) Explain how economics influence the engineering designs?

(10x3 marks =30 marks)

Part B

Answer any ONE question from each module. Each question carry 14 marks

Module 1

(11) Show the designing of a wrist watch going through the various stages of the design process. Use hand sketches to illustrate the processes.

or

(12)Find the customer requirements for designing a new car showroom. Show how the design objectives were finalized considering the design constraints?

Module 2

(13)Illustrate the design thinking approach for designing a bag for college students within a limited budget. Describe each stage of the process and the iterative procedure involved. Use hand sketches to support your arguments.

or

(14)Construct a number of possible designs and then refine them to narrow down to the best design for a drug trolley used in hospitals. Show how the divergent-convergent thinking helps in the process. Provide your rationale for each step by using hand sketches only.

Module 3

(15) Graphically communicate the design of a thermo flask used to keep hot coffee. Draw the detailed 2D drawings of the same with design detailing, material selection, scale drawings, dimensions, tolerances, etc. Use only hand sketches.

or

(16)Describe the role of mathematical modelling in design engineering. Show how mathematics and physics play a role in designing a lifting mechanism to raise 100 kg of weight to a floor at a height of 10 meters in a construction site.

Module 4

(17) Show the development of a nature inspired design for a solar poweredbus waiting shed beside a highway. Relate between natural and man-made designs. Use hand sketches to support your arguments.

or

(18)Show the design of a simple sofa and then depict how the design changes when considering 1) aesthetics and 2) ergonomics into consideration. Give hand sketches and explanations to justify the changes in designs.

Module 5

(19)Examine the changes in the design of a foot wear with constraints of 1) production methods, 2) life span requirement, 3) reliability issues and 4) environmental factors. Use hand sketches and give proper rationalization for the changes in design.

or

(20)Describe the how to estimate the cost of a particular design using ANY of the following: i) a website, ii) the layout of a plant, iii) the elevation of a building, iv) anelectrical or electronic system or device and v) a car.

Show how economics will influence the engineering designs. Use hand sketches to support your arguments.

(5x14 marks =70 marks)

Syllabus

Module 1

Design Process:- Introduction to Design and Engineering Design, Defining a Design Process-:Detailing Customer Requirements, Setting Design Objectives, Identifying Constraints, Establishing Functions, Generating Design Alternatives and Choosing a Design.

Module 2

Design Thinking Approach:-Introduction to Design Thinking, Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. Design Thinking as Divergent-Convergent Questioning. Design Thinking in a Team Environment.

Module 3

Design Communication (Languages of Engineering Design):-Communicating Designs Graphically, Communicating Designs Orally and in Writing. Mathematical Modeling In Design, Prototyping and Proofing the Design.

Module 4

Design Engineering Concepts:-Project-based Learning and Problem-based Learning in Design.Modular Design and Life Cycle Design Approaches. Application of Bio-mimicry,Aesthetics and Ergonomics in Design. Value Engineering, Concurrent Engineering, and Reverse Engineering in Design.

Module 5

Expediency, Economics and Environment in Design Engineering:-Design for Production, Use, and Sustainability. Engineering Economics in Design. Design Rights. Ethics in Design

Text Books

1) YousefHaik, SangarappillaiSivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 9781305253285,

2) Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN 9332535051

Reference Books

1.Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition, ISBN: 9780128012420.
2. Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
3. Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361
4. Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Design Process**	
1.1	Introduction to Design and Engineering Design. *What does it mean to design something? How Is engineering design different from other kinds of design? Where and when do engineers design? What are the basic vocabularyin engineering design? How to learn and do engineering design.*	1
1.2	*Defining a Design Process*-: Detailing Customer Requirements. *How to do engineering design? Illustrate the process with an example. How to identify the customer requirements of design?*	1
1.3	*Defining a Design Process*-: Setting Design Objectives, Identifying Constraints, Establishing Functions. *How to finalize the design objectives? How to identify the design constraints? How to express the functions a design in engineering terms?*	1
1.4	*Defining a Design Process*-: Generating Design Alternatives and Choosing a Design. *How to generate or create feasible design alternatives? How to identify the "best possible design"?*	1
1.5	Case Studies:- Stages of Design Process. *Conduct exercises for designing simple products going through the different stages of design process.*	1
2	**Module 2: Design Thinking Approach**	
2.1	Introduction to Design Thinking *How does the design thinking approach help engineers in creating innovative and efficient designs?*	1
2.2	Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test. *How can the engineers arrive at better designs utilizing the iterative design thinking process (in which knowledge acquired in the later stages can be applied back to the earlier stages)?*	1
2.3	Design Thinking as Divergent-Convergent Questioning. *Describe how to create a number of possible designs and then how to refine and narrow down to the 'best design'.*	1
2.4	Design Thinking in a Team Environment. *How to perform design thinking as a team managing the conflicts ?*	1
2.5	Case Studies: Design Thinking Approach. *Conduct exercises using the design thinking approach for*	1

	designing any simple products within a limited time and budget	
3	**Module 3: Design Communication (Languages of Engineering Design)**	
3.1	Communicating Designs Graphically. *How do engineering sketches and drawings convey designs?*	1
3.2	Communicating Designs Orally and in Writing. *How can a design be communicated through oral presentation or technical reports efficiently?*	1
First Series Examination		
3.3	Mathematical Modelling in Design. *How do mathematics and physics become a part of the design process?*	1
3.4	Prototyping and Proofing the Design. *How to predict whether the design will function well or not?*	1
3.5	Case Studies: Communicating Designs Graphically. *Conduct exercises for design communication through detailed 2D or 3D drawings of simple products with design detailing, material selection, scale drawings, dimensions, tolerances, etc.*	1
4	**Module 4: Design Engineering Concepts**	
4.1	Project-based Learning and Problem-based Learning in Design. *How engineering students can learn design engineering through projects?* *How students can take up problems to learn design engineering?*	1
4.2	Modular Design and Life Cycle Design Approaches. *What is modular approach in design engineering? How it helps?* *How the life cycle design approach influences design decisions?*	1
4.3	Application of Bio-mimicry, Aesthetics and Ergonomics in Design. *How do aesthetics and ergonomics change engineering designs?* *How do the intelligence in nature inspire engineering designs? What are the common examples of bio-mimicry in engineering?*	1
4.4	Value Engineering, Concurrent Engineering, and Reverse Engineering in Design. *How do concepts like value engineering , concurrent engineering and reverse engineering influence engineering designs?*	1
4.5	Case Studies: Bio-mimicry based Designs. *Conduct exercises to develop new designs for simple*	1

	products using bio-mimicry and train students to bring out new nature inspired designs.	
5	**Module 5: Expediency, Economics and Environment in Design Engineering**	
5.1	Design for Production, Use, and Sustainability. *How designs are finalized based on the aspects of production methods, life span, reliability and environment?*	1
5.2	Engineering Economics in Design. *How to estimate the cost of a particular design and how will economics influence the engineering designs?*	1
5.3	Design Rights. *What are design rights and how can an engineer put it into practice?*	1
5.4	Ethics in Design. *How do ethics play a decisive role in engineering design?*	1
5.5	Case Studies: Design for Production, Use, and Sustainability. *Conduct exercises using simple products to show how designs change with constraints of production methods, life span requirement, reliability issues and environmental factors.*	1
	Second Series Examination	

Code.	Course Name	L	T	P	Hrs	Credit
HUT 200	**Professional Ethics**	2	0	0	2	2

Preamble: To enable students to create awareness on ethics and human values.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the core values that shape the ethical behaviour of a professional.
CO 2	Adopt a good character and follow an ethical life.
CO 3	Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.
CO 4	Solve moral and ethical problems through exploration and assessment by established experiments.
CO 5	Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1								2			2	
CO 2								2			2	
CO 3								3			2	
CO 4								3			2	
CO 5								3			2	

Assessment Pattern

Bloom's category	Continuous Assessment Tests		End Semester Exam
	1	2	
Remember	15	15	30
Understood	20	20	40
Apply	15	15	30

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	:	10 marks
Continuous Assessment Tests (2 Nos)	:	25 marks
Assignments/Quiz	:	15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

<u>Course Level Assessment Questions</u>

Course Outcome 1 (CO1):

1. Define integrity and point out ethical values.
2. Describe the qualities required to live a peaceful life.
3. Explain the role of engineers in modern society.

Course Outcome 2 (CO2)

1. Derive the codes of ethics.
2. Differentiate consensus and controversy.
3. Discuss in detail about character and confidence.

Course Outcome 3(CO3):

1. Explain the role of professional's ethics in technological development.
2. Distinguish between self interest and conflicts of interest.
3. Review on industrial standards and legal ethics.

Course Outcome 4 (CO4):

1. Illustrate the role of engineers as experimenters.
2. Interpret the terms safety and risk.
3. Show how the occupational crimes are resolved by keeping the rights of employees.

Course Outcome 5 (CO5):

1. Exemplify the engineers as managers.
2. Investigate the causes and effects of acid rain with a case study.
3. Explorate the need of environmental ethics in technological development.

Model Question paper

QP CODE: **Reg No:______________**

PAGES:3 **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY THIRD/FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 200

Course Name: PROFESSIONAL ETHICS

Max. Marks: 100 **Duration: 3 Hours**

(2019-Scheme)

PART A

(Answer all questions, each question carries 3 marks)

1. Define empathy and honesty.
2. Briefly explain about morals, values and ethics.
3. Interpret the two forms of self-respect.
4. List out the models of professional roles.
5. Indicate the advantages of using standards.
6. Point out the conditions required to define a valid consent?
7. Identify the conflicts of interests with an example?
8. Recall confidentiality.
9. Conclude the features of biometric ethics.
10. Name any three professional societies and their role relevant to engineers.

(10x3 = 30 marks)

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Classify the relationship between ethical values and law?

b) Compare between caring and sharing. (10+4 = 14 marks)

Or

12. a) Exemplify a comprehensive review about integrity and respect for others.

b) Discuss about co-operation and commitment. (8+6 = 14 marks)

MODULE II

13.a) Explain the three main levels of moral developments, deviced by Kohlberg.

b) Differentiate moral codes and optimal codes. (10+4 = 14 marks)

Or

14. a) Extrapolate the duty ethics and right ethics.

b) Discuss in detail the three types of inquiries in engineering ethics (8+6 = 14 marks)

MODULE III

15.a) Summarize the following features of morally responsible engineers.

(i) Moral autonomy **(ii)** Accountability

b)Explain the rights of employees (8+6 = 14 marks)

Or

16. a) Explain the reasons for Chernobyl mishap ?

b) Describe the methods to improve collegiality and loyalty. (8+6 = 14 marks)

MODULE IV

17.a) Execute collegiality with respect to commitment, respect and connectedness.

b) Identify conflicts of interests with an example. (8+6 = 14 marks)

Or

18. a) Explain in detail about professional rights and employee rights.

b) Exemplify engineers as managers.

MODULE V

19.a) Evaluate the technology transfer and appropriate technology.

b) Explain about computer and internet ethics. (8+6 = 14 marks)

Or

20. a) Investigate the causes and effects of acid rain with a case study.

b) Conclude the features of ecocentric and biocentric ethics. (8+6 = 14 marks)

Syllabus

Module 1 – Human Values.

Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue-Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment-Empathy-Self Confidence -Social Expectations.

Module 2 - Engineering Ethics & Professionalism.

Senses of Engineering Ethics - Variety of moral issues- Types of inquiry- Moral dilemmas –Moral Autonomy – Kohlberg's theory- Gilligan's theory- Consensus and Controversy-Profession and Professionalism- Models of professional roles-Theories about right action –Self interest-Customs and Religion- Uses of Ethical Theories.

Module 3- Engineering as social Experimentation.

Engineering as Experimentation – Engineers as responsible Experimenters- Codes of Ethics- Plagiarism-A balanced outlook on law - Challenges case study- Bhopal gas tragedy.

Module 4- Responsibilities and Rights.

Collegiality and loyalty – Managing conflict- Respect for authority- Collective bargaining- Confidentiality-Role of confidentiality in moral integrity-Conflicts of interest- Occupational crime- Professional rights-Employee right- IPR Discrimination.

Module 5- Global Ethical Issues.

Multinational Corporations- Environmental Ethics- Business Ethics- Computer Ethics -Role in Technological Development-Engineers as Managers- Consulting Engineers- Engineers as Expert witnesses and advisors-Moral leadership.

Text Book

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited ,New Delhi,2006.

Reference Books

1. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi,2014.
2. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey,2004.
3. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states,2005.
4. http://www.slideword.org/slidestag.aspx/human-values-and-Professional-ethics.

Course Contents and Lecture Schedule

SL.No	Topic	No. of Lectures 25
1	**Module 1 – Human Values.**	
1.1	Morals, values and Ethics, Integrity, Academic Integrity,Work Ethics	1
1.2	Service Learning, Civic Virtue, Respect for others, Living peacefully	1
1.3	Caring and Sharing, Honesty, Courage, Co-operation commitment	2
1.4	Empathy, Self Confidence, Social Expectations	1
2	**Module 2- Engineering Ethics & Professionalism.**	
2.1	Senses of Engineering Ethics, Variety of moral issues, Types of inquiry	1
2.2	Moral dilemmas, Moral Autonomy, Kohlberg's theory	1
2.3	Gilligan's theory, Consensus and Controversy,Profession& Professionalism, Models of professional roles, Theories about right action	2
2.4	Self interest-Customs and Religion, Uses of Ethical Theories	1
3	**Module 3- Engineering as social Experimentation.**	
3.1	Engineering as Experimentation, Engineers as responsible Experimenters	1
3.2	Codes of Ethics,Plagiarism, A balanced outlook on law	2
3.3	Challenger case study, Bhopal gas tragedy	2
4	**Module 4- Responsibilities and Rights.**	
4.1	Collegiality and loyalty, Managing conflict, Respect for authority	1
4.2	Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Conflicts of interest	2
4.3	Occupational crime, Professional rights, Employee right, IPR Discrimination	2
5	**Module 5- Global Ethical Issues.**	
5.1	Multinational Corporations, Environmental Ethics, Business Ethics, Computer Ethics	2
5.2	Role in Technological Development, Moral leadership	1
5.3	Engineers as Managers, Consulting Engineers, Engineers as Expert witnesses and advisors	2

SEMESTER V

BTT301	INDUSTRIAL BIOPROCESS TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: The students will be able to understand the importance of microbes in Industrial production processes and the various methods involved.

Prerequisite: Basic knowledge about media formulation, sterilization and fermentation

Course Outcomes: After the completion of the course the student will be able to

CO 1	Appreciate the use of microorganisms for the production of value-added commodities
CO 2	Describe key industrial bioprocesses, from the traditional to the recently evolved
CO 3	Understand the biological and engineering principles involved in the production of bio products and enzymes
CO 4	Summarize the Market economics in the production of a bio product

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	-	-	-	-	-	-	-	2	-	-
CO 2	3	-	-	-	-	-	-	-	-	-	3	-
CO 3	2	-	-	-	-	-	-	3	-	-	3	-
CO 4	3	-	-	-		-	-	-	-	2		-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Appreciate the use of microorganisms for the production of value-added commodities

1. Write short note on culture preservation of microorganisms
2. Justify using the example of penicillin the need for life scientists and engineers to work together for bring a bio product to market.
3. Explain the production process of Streptomycin with neat labeled flow diagram.

Course Outcome 2 (CO2): Describe key industrial bioprocesses, from the traditional to the recently evolved.

1. Discuss the strain improvement method for the overproduction of primary and secondary metabolites
2. Explain the quick method of Acetic acid production
3. With a neat flow sheet, explain the manufacture of citric acid using a submerged fermentation

Course Outcome 3(CO3): Understand the biological and engineering principles involved in the production of bio products and enzymes

1. Discuss the application of enzymes in laundry industry
2. Explain the role of enzymes in textile and tanning industry

3. Give detailed account of poly hydroxyl butarate production by microbial system starting from glucose as carbon source

Course Outcome 4 (CO4): Summarize the market economics in the production of a bio product

1. Define Energy conservation and energy audit. Explain its importance in bioprocess plant?
2. What are GMP and cGMP and mention its basic guidelines
3. Differentiate between capital and working costs with examples of each.

Model Question Paper

		Total Pages:
Reg No.:_______________		Name:__________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH SEMESTER B. TECH DEGREE EXAMINATION_____________20_		
Course Code: BTT 301		
Course Name: INDUSTRIAL BIOPROCESS TECHNOLOGY		
Max. Marks: 100		Duration: 3 Hours
PART A		

		Answer all questions, each carries 3 marks.
1	a)	How can you improve the strain of industrially important micro organisms by various methods?
	b)	Explain any two mechanisms of regulating enzyme synthesis.
	c)	Differentiate between capital and working costs with examples of each in Bio processing industry
	d)	Describe about steady state, batch and continuous process
	e)	Explain the market economics related to current industrial bio technology.
	f)	Differentiate between homo fermentation and hetero fermentation in lactic acid production
	g)	Enumerate the role of precursors and inducers in secondary metabolite production
	h)	List out any three enzymes used in brewing with their role?
	i)	What are monoclonal antibodies?
	j)	Explain the role of blood factor VIII

		PART B	
		Answer any one full question from each module. Each carries 14 marks.	
2	a)	Elaborate using an example on the various unit operations in the upstream and downstream bioprocess of a new age bio product.	(10)
	b)	Explain about Process flow sheet	(4)
		OR	
3	a)	Explain the strain improvement techniques in detail?	(10)
	b)	Discuss rDNA technology	(4)
4	a)	With a neat flow diagram, explain ABE fermentation process.	(8)
	b)	Outline the problems associated the purification of ethanol.	(6)
		OR	
5	a)	Outline the submerged and surface process of citric acid production	(8)
	b)	Explain the industrial production of chloramphenicol	(6)
6	a)	What are monoclonal antibodies? Discuss principle utilized and the methods followed in the preparation of monoclonal antibodies with neat diagram	(14)
		OR	
7	a	Explain the production the therapeutic applications of Blood Factor VIII and Erythropoietin	(14
8	a	Mention the importance any two enzymes used in i) Paper and pulp industries. ii) Textile industries.	(8)
	b	Mention the relevance any three enzymes in tanning industry	
		OR	
9	a)	Explain any two chromatographic methods employed for enzyme purification.	(6)
	b)	Describe the industrial production of citric acid with a neat flow diagram.	(8)
10	a)	With a neat sketch explain the industrial manufacture of streptokinase. Mention the strains used, the downstream processing, substrate used and process conditions	(14)
		OR	
11	a)	Describe the process of the manufacture of the biopolymer PHB with a flow chart	(6)
	b)	What are vaccines? With a neat diagram, explain the principle and manufacturing process of Hepatitis B Vaccine.	(8)
		****	

Syllabus

Module 1:

Introduction to fermentation processes: The range of fermentation processes.

A review of various industrial fermentation processes: the chronological development of the fermentation industry. The component parts of a fermentation process.

Role of a Bioprocess Engineer, Process flow sheeting, outline of the various unit operations used in upstream and downstream operations in a bioprocess industry. Isolation, preservation and improvement of industrially important micro-organisms. Improvement of industrial strains by modifying properties other than the yield of product-(selection of stable strains, strains resistant to infection, strains which are resistant to components in the medium)

Use of recombinant DNA technology: for native microbial product improvement. Regulation of enzyme activity, Catabolite repression and its role in industrial production processes.

Module 2:

Development of inoculum for industrial fermentations: Criteria for the transfer of inoculums, development of inoculum for yeast and bacterial cultures.

Market economics of a Bioprocess Industry: Capital cost estimation - operating cost estimation - profitability analysis - GMP and cGMP, Utilities in a bioprocess plant.

Effluent treatment: General Treatment and disposal methods of effluents generated from fermentation industry.

Module 3:

Production and purification of primary metabolites: Industrial processes for the

Manufacture with the important engineering problems involved in the manufacture of the following products with flow diagram, reactions and conditions: Organic acids: Citric acid, lactic acid,, acetic acid, Amino acids: Glutamic acid, Lysine . Alcohols: Ethyl alcohol, Acetone- butanol fermentation process, production and purification of secondary metabolites: beta lactams: Penicillin and cephalosporin; aminoglycosides - streptomycin, kanamycin; macrolides- erythromycin, aromatics: griseofulvin, Production of vitamins: vitamin B2, B12, Steroid transformation process.

Module 4:

Microbial production of industrial enzymes: Proteases, amylases and lipase, general methods of purification of enzymes, application of enzymes : In Textiles and Laundry

Detergents, Pulp and Paper industry - Tanning Industry, Sugar and starch industry, production of single cell protein(yeast and Algae)

Module 5:

Production of recombinant proteins :Manufacture of human insulin - Interferon, Erythropoietin, , Tissue plasminogen activator , Blood factor VIII , Hepatitis B Vaccine -Monoclonal antibodies for therapeutics, products of eco-friendly technology : Production of xanthan gum, PHB, Nisin,Biofertilizer (Rhizobium, Azotobacter) and Bio pesticide(Bacillus thuriengiensis)

Text Books

1. Casida Jr, L. E, Industrial Microbiology, New Age International (P) Ltd., 1996.
2. Cruger W. and A. Crueger, Biotechnology: A Textbook of Industrial Microbiology

Reference Books

1. S. C. Prescott, C. G. Dunn, Industrial Microbiology, Agrobios, 2005
2. 1. E M T El Mansi, C F A Bryce, B Dahhou S Sanchez, A L Demain, A R Allmen, *Fermentation microbiology and biotechnology*, CRC Press, 2012.
3. P F Stanbury, A Whitaker and S J Hall, *Principles of Fermentation Technology,* Elsevier, 1995.
4. K. Buchholz, V. Kasche, U.T. Bornscheuer, Biocatalysts and Enzyme Technology, WILEYVCH, 2005.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Introduction to fermentation processes**	
1.1	The range of fermentation processes, A review of various industrial fermentation process: the chronological development of the fermentation industry.	1
1.2	The component parts of a fermentation process. Role of a Bioprocess Engineer	1
1.3	Process flow sheeting	1
1.4	Outline of the various unit operations used in upstream and downstream operations in a bioprocess industry.	1
1.5	Isolation, preservation and improvement of industrially important micro-organisms	1
1.6	Improvement of industrial strains by modifying properties other than the yield of product-(selection of stable strains, strains resistant to infection, strains which are resistant to components	2

	in the medium)	
1.7	Use of recombinant DNA technology for the improvement of native microbial products.	1
1.8	Regulation of enzyme activity, catabolite repression and its role in industrial production process.	1
2	**Module 2: Development of inoculum for industrial fermentations:**	
2.1	Criteria for the transfer of inoculums	1
2.2	Criteria for the transfer of inoculums	
2.3	The development of inoculum for yeast and bacterial culture	1
2.4	Market economics of a Bioprocess Industry: Capital cost estimation	1
2.5	operating cost estimation	1
2.6	profitability analysis - GMP and cGMP	1
2.7	Utilities in a bioprocess plant	1
2.8	Effluent treatment: General Treatment and disposal methods of effluents generated from fermentation industry,	1
3	**Module 3 :Production and purification of primary metabolites :**	
3.1	Industrial processes for the manufacture with the important engineering problems involved in the manufacture of the following products with flow diagram, reactions and conditions: Organic acids: Citric acid	1
3.2	Lactic acid	1
3.3	Acetic acid.	1
3.4	Amino acids: Glutamic acid, Lysine.	1
3.5	Alcohols : Ethyl alcohol , Acetone- butanol fermentation process	1
3.6	Production and purification of secondary metabolites : beta lactams : Penicillin and cephalosporin	1
3.7	Aminoglycosides - streptomycin	1
3.8	kanamycin	1
3.9	macrolides- erythromycin, ,	1
3.10	Aromatics: griseofulvin.	1
3.11	Production of vitamins: vitamin B2, B12	1
3.12	Steroid transformation process.	1
4	**Module 4 :Microbial production of industrial enzymes:**	
4.1	Proteases	1
4.2	Amylases	1
4.3	Lipase	1
4.4	General methods of purification of enzymes	1
4.5	Application of enzymes : In Textiles and Laundry Detergents	1
4.6	Pulp and Paper industry	1
4.7	Tanning Industry	1
4.8	Sugar and starch industry	1
4.9	Production of single cell protein(yeast and Algae)	1
5	**Module 5: Production of recombinant proteins :**	

5.1	Manufacture of human insulin	1
5.2	Interferon	1
5.3	Erythropoietin	1
5.4	Tissue plasminogen activator	1
5.5	Blood factor VIII , Hepatitis B Vaccine	1
5.6	Monoclonal antibodies for therapeutics	1
5.7	Products of eco-friendly technology : Production of xanthan gum, PHB, Nisin	1
5.8	Bio fertilizer (*Rhizobium*, *Azotobacte*r) and Bio pesticide(*Bacillus thuriengiensis*	1

BTT303	MASS TRANSFER OPERATIONS	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: To provide students with fundamental concepts of mass transfer and an understanding of the most important separation processes in a process industry.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify the mechanisms of mass transfer and formulate the rate equations
CO 2	Select suitable separation equipment for a given separation
CO 3	Apply material and energy balance to determine different mass transfer operations
CO 4	Design different extraction and drying operations

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2	3	2	-	2	2	-	-	-	-	2
CO 2	3	2	3	2	-	2	2	-	-	-	-	-
CO 3	2	2	3	-	-	2	2	-	-	-	-	-
CO 4	2	2	3	-	-	2	2	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Identify the mechanisms of mass transfer and formulate the rate equations

1. State and explain Fick's laws of diffusion.
2. Compare film theory and penetration theory of mass transfer.
3. Derive the expression for steady state diffusion of one component into another non-diffusing component.

Course Outcome 2 (CO2): Select suitable separation equipment for a given separation

1. Describe the importance of minimum Liquid- Gas ratio in the design of absorbers.
2. A binary liquid mixture containing 50 mole% of the more volatile component is fed to a heater where 40% of the feed is flash vaporized. If the liquid and vapour produced are in equilibrium, calculate the composition of the liquid product obtained (in mole %). Relative volatility may be taken as 2.0.
3. Discuss the criteria of a good solvent for extraction.

Course Outcome 3(CO3): Apply material and energy balance to determine different mass transfer operations

1. Develop material balance for one component transferred in counter current absorption.

2. Develop the design equations for multistage cross current extraction with partially miscible and completely immiscible solvents.

3. Explain the terms extract and raffinate.

Course Outcome 4 (CO4): Design different extraction and drying operations

1. Give four examples of Adsorbents used in Adsorption.

2. With a neat diagram describe the construction and working of a Bollman Extractor.

3. With a neat sketch describe the operation of (i) Tray Dryer and (ii) Spray Dryers.

Model Question Paper

		Total Pages:
Reg No.:_______________		Name:___________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH SEMESTER B. TECH DEGREE EXAMINATION_____________20_		
Course Code: BTT303		
Course Name: MASS TRANSFER OPERATIONS		
Max. Marks: 100		Duration: 3 Hours

PART A		
		Answer all questions, each carries 3 marks.
1	(a)	Enunciate the significance of interphase mass transfer.
	(b)	Explain film theory of mass transfer with a neat diagram.
	(c)	Define absorption factor and stripping factor using Kremser equation.
	(d)	Compare tray towers and packed towers.
	(e)	Verify Rayleigh's equation.
	(f)	Explain the physical significance of any two dimensionless numbers in mass transfer.
	(g)	Demonstrate industrial application of solid liquid extraction with relevant examples.
	(h)	Specify the adsorption Equilibrium.
	(i)	Describe the breakthrough curve in fixed bed adsorption.
	(j)	Differentiate free and equilibrium moisture content in drying.
PART B		
Answer any one full question from each module. Each carries 14 marks.		

2	(a)	Derive the expression for steady state diffusion of one component into another non-diffusing component.	(8)
	(b)	Oxygen is diffusing in a mixture of oxygen-nitrogen at 1 atm, 25 ^{0}C. Concentration of oxygen at planes 2mm apart are 10 and 20 volume % respectively. Nitrogen is non-diffusing. Calculate the molar flux of oxygen. Diffusivity of oxygen in nitrogen is 1.89 x 10^{-5} m^2/ sec.	(6)
		OR	
3		Derive the relation between individual and overall mass transfer coefficient.	(14)
4	(a)	Derive an expression the number of gas transfer unit for absorption of one component in counter current operation.	(8)
	(b)	With the help of a neat diagram explain the working of pulsed column extractor.	(6)
		OR	
5		Develop the design equations for multistage cross current extraction with partially miscible and completely immiscible solvents.	(14)
6	(a)	Discuss the significance of total reflux ratio and minimum reflux ratio	(8)
	(b)	A binary liquid mixture containing 50 mole% of the more volatile component is fed to a heater where 40% of the feed is flash vaporized. If the liquid and vapour produced are in equilibrium, calculate the composition of the liquid product obtained (in mole %). Relative volatility may be taken as 2.0.	(6)
		OR	
7	(a)	Derive the equations for Operating lines of enriching and stripping sections using Mc-Cabe Thiele method. State the assumptions.	(8)
	(b)	A continuous fractionating column is to be designed to separate 3 kg/s of a mixture of 70% benzene and 40% toluene to get an overhead product of 95% toluene and a residue of 97% benzene by mass. Calculate the mass of product & residue per unit time.	(6)
8	(a)	Discuss Industrial applications of leaching.	(6)
	(b)	Explain heap leaching and In-situ Leaching	(8)
		OR	
9	(a)	Compare and contrast fixed bed and agitated bed adsorption.	(8)
	(b)	Explain the adsorption column dynamics.	(6)

10	(a)	A wet solid is to be dried from 40 % to 10 % moisture under constant drying conditions in six hours. If the equilibrium moisture content is 5 % and the critical moisture content is 15%, how long it will take to dry the solids to 6 % moisture under the same conditions.	(8)
	(b)	With the help of a schematic diagram explain the construction, working and fields of application of a tunnel dryer	(6)
		OR	
11	(a) (b)	Classify and describe the various regimes of drying. Explain any two-batch drying equipment.	(8) (6)
		****	

Syllabus

Module 1

Mass transfer operations: Classification, Fick's law of diffusion, Measurement of diffusivity, one component transferring to non-diffusing component and equimolar counter diffusion. Diffusivity in gases. Theories of mass transfer: Film theory, Penetration theory, Surface Renewal theory. Convective mass transfer, Mass transfer coefficients. Interphase mass transfer, Dimensionless numbers. Molecular diffusion in biological solutions and gels.

Module 2

Absorption-Solubilities of gases in liquids, Material balances for one component transferred in counter current and cocurrent flows, Minimum Liquid-Gas Ratio for Absorbers, one component transferred in counter current multistage operation, Continuous-contact equipment.

Liquid-liquid Extraction- principle, Industrial applications, Selection of a solvent for good extraction, Single stage, cross current and counter current extraction, Liquid-liquid extraction equipments.

Module 3

Distillation- Principle, Vapour- Liquid Equilibrium, Raoult's law, Daltons law, Relative volatility, Azeotropes, Flash vaporization, Simple distillation, Rayleigh's equation, Steam distillation- Applications, General characteristics of tray and packed towers.

Continuous fractionation, Material and energy balance in a continuous fractionator, McCabe-Thiele method (only), Total reflux ratio, minimum reflux ratio, optimum reflux ratio, feed tray location, total condenser and partial condenser, reboiler.

Module 4

Solid-Liquid extraction (Leaching), Industrial applications, Heap and In-situ Leaching, Single stage and multistage leaching, Leaching equipment, solid-liquid equilibria.

Adsorption: Adsorption equilibrium, adsorbent types, equipment operation- adsorption column dynamics- fixed bed and agitated bed adsorption, scale up of adsorption processes- LUB method

Module 5

Drying - Principle, Heat and mass transfer in drying applications, Commercial dryers- tray dryers, vacuum dryers, fluidized bed dryers, tunnel dryers, freeze dryers, spray dryers, Different regimes of drying, Cross circulation and Through circulation drying, Freeze drying, Material and energy balance in a continuous counter current dryer, Drying time, scale up and design of drying systems.

Text Books

1. Robert E Treybal, *Mass Transfer Operations*, 3/e, McGraw Hill,1980.
2. K V Narayanan & B Lakshmikutty, *Mass Transfer Theory and Applications,* CBS Publishers and Distributors Pvt Ltd. 2014
3. Binay K Dutta, *Principles of Mass Transfer and Separation Processes*, PHI Learning Pvt. Ltd., 2015.
4. N Anantharaman, K M Meera Sheriffa Begum, *Mass Transfer: Theory and Practice*, PHI Learning Pvt. Ltd., 2011.

Reference Books

1. Christie J Geankoplis, *Transport Processes and Separation Process Principles*, 4/e, Prentice Hall, 2003.
2. Warren L McCabe, Julian C Smith, P Harriot, *Unit operations of chemical Engineering*, 7/e, McGraw Hill, 2005.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Mass Transfer Operations**	
1.1	Classification of mass transfer operations. Fick's law of diffusion Measurement of diffusivity	2
1.2	One component transferring to non-diffusing component and equimolar counter diffusion. Diffusivity in gases. Theories of mass transfer such as Film theory, Penetration theory, Surface Renewal theory.	5
1.3	Convective mass transfer, Mass transfer coefficients. Interphase	3

	mass transfer, Dimensionless numbers. Molecular diffusion in biological solutions and gels.	
2	**Absorption and Extraction**	
2.1	**Absorption**-Solubilities of gases in liquids, Material balances for one component transferred in counter-current and co-current flows	2
2.2	Minimum Liquid-Gas Ratio for Absorbers, One component transferred in counter current multistage operation, Continuous-contact equipment.	2
2.3	**Liquid-liquid Extraction**- principle, Industrial applications, Selection of a solvent for good extraction	2
2.4	Single stage, cross current and counter current extraction, Liquid-liquid extraction equipment	3
3	**Distillation and Fractionation**	
3.1	**Distillation**- Principle, Vapour- Liquid Equilibrium, Raoult's law, Daltons law, Relative volatility, Azeotropes, Flash vaporization, Simple distillation, Rayleigh's equation	2
3.2	Steam distillation- Applications, General characteristics of tray and packed towers.	2
3.3	**Continuous fractionation**, Material and energy balance in a continuous fractionator, McCabe-Thiele method (only)	3
3.4	Total reflux ratio, minimum reflux ratio, optimum reflux ratio, feed tray location, total condenser and partial condenser, reboiler.	2
4	**Solid-Liquid Extraction and Adsorption**	
4.1	**Solid-Liquid extraction** (Leaching), Industrial applications, Heap and In-situ Leaching, Single stage and multistage leaching, Leaching equipment, solid-liquid equilibria.	3
4.2	**Adsorption**: Adsorption equilibrium, adsorbent types, equipment operation- adsorption column dynamics	3
4.3	Fixed bed and agitated bed adsorption, scale up of adsorption processes- LUB method	2
5	**Drying**	
5.1	**Drying** - Principle, Heat and mass transfer in drying applications, Commercial dryers- tray dryers, vacuum dryers, fluidized bed dryers, tunnel dryers, freeze dryers, spray dryers	3
5.2	Different regimes of drying, Cross circulation and Through circulation drying, Freeze drying	3
5.3	Material and energy balance in a continuous counter current dryer, Drying time, scale up and design of drying systems.	3

BTT305	MOLECULAR BIOLOGY	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: Articulate applications of Molecular Biology in the modern world

Prerequisite: Basics of Biochemistry

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply the knowledge of the basic structure and biochemistry of nucleic acids discriminate between them
CO 2	Evaluate the relation between of DNA replication, transcription and translation and explain their principle
CO 3	Understand the basic mechanisms involved in mutagenesis
CO 4	Articulate the role of gene organization and gene regulation in prokaryotes and eukaryotes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	2	-	-	-	-	-	-	-	-
CO2	3	2	3	2	-	-	-	-	-	-	-	-
CO3	2	3	2	3	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Apply the knowledge of the basic structure and biochemistry of nucleic acids and discriminate between them

1. Distinguish the different forms of DNA
2. Illustrate the central dogma in molecular biology
3. Elaborate on the different structural and functional characteristics of the different types of RNA

Course Outcome 2 (CO2): Evaluate the relation between of DNA replication, transcription and translation and explain their principle

1. Write notes on the important proteins involved in prokaryotic replication
2. Distinguish the transcription process in prokaryotes in comparison with eukaryotes
3. What are the steps involved in post translational modifications?

Course Outcome 3(CO3): Understand the basic mechanisms involved in mutagenesis and DNA repair

1. Cite examples of mutagens that cause DNA damage
2. Elaborate on the types of mutations
3. Explain the mechanisms involved in DNA repair

Course Outcome 4 (CO4): Articulate the role of gene organization and gene regulation in prokaryotes and eukaryotes

1. Differentiate constitutive and induced enzymes
2. How is the Lac operon regulated?
3. Illustrate the significance of catabolite repression

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION______________20_

Course Code: BTT 305

Course Name: MOLECULAR BIOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	(a)	Distinguish the structural characteristics of rRNA in prokaryotes and eukaryotes
	(b)	What are the salient features of a tRNA?
	(c)	Explain the important aspects of semi conservative DNA replication.
	(d)	Elaborate on any one of the DNA repair mechanisms
	(e)	Write a note on the types of RNA polymerases.
	(f)	What is the significance of mRNA splicing?
	(g)	Highlight on the wobble hypothesis and codon usage.
	(h)	Explain the activation of aminoacyltRNA
	(i)	Comment on inducible enzyme with an example
	(j)	What are base analogues and explain their role in mutation?

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Compare and contrast the structure and functions of different types of RNA in prokaryotes and eukaryotes	(14)
		OR	
3		Discuss the experiments that proved DNA as the genetic material	(14)
4		Elaborate on the steps and proteins involved in the replication of eukaryotic DNA	(14)
		OR	
5		Describe in detail about the types of DNA repair mechanism	(14)
6		Distinguish the transcription process in prokaryotes from eukaryotes	(14)
		OR	
7	(a)	Explain post transcriptional modification	(9)
	(b)	Write notes on inhibitors of transcription	(5)
8		Describe the steps involved in eukaryotic translation	(14)
		OR	
9		Elaborate on DNA binding domains and motifs.	(14)
10	(a)	Describe the regulation of gene expression in tryptophan operon	(9)

	(b)	What are the analogues of lactose? Define induction.	(5)
		OR	
11		Elaborate on transposons and retroposons	(14)
****			

Syllabus

Module 1: Chemistry of nucleic acids

Identification of the genetic material - classical experiments: Griffith's, Avery McLeod, Hershey and Chase. Structure of DNA, different forms of DNA, DNA denaturation and their melting curves. Structure of RNA: mRNA, rRNA and tRNA - primary, secondary, tertiary structures and functions. Central dogma of molecular biology, Chromosome organization in eukaryotes.

Module 2: DNA Replication

Models of DNA replication- Experimental evidence for the semi conservative mode. Mechanism of DNA replication in *E.coli* (bidirectional) and Viral DNA (Rolling circle), Enzymes and Protein factors involved in replication. Chromosomal replication of eukaryotes; Regulation of DNA replication. Overview of mutations - Types of mutagens and mutations. Mechanisms of replication repair in prokaryotes and eukaryotes.

Module 3: Transcription

RNA synthesis in prokaryotes and eukaryotes: Initiation, elongation and termination of RNA synthesis.Components of transcription machinery in prokaryotes and eukaryotes, Transcription factors. Proteins involved in RNA synthesis, Fidelity of RNA synthesis, Inhibitors of transcription. Post transcriptional processing of RNA's- tRNA, rRNA, mRNA. Reverse transcription

Module 4: Translation:

The genetic code, Wobble hypothesis and codon usage. Protein synthesis in prokaryotes and eukaryotes, protein factors involved in protein synthesis, post translational modifications, inhibitors of translation. Variants of gene- Split genes, Pseudogenes, Overlapping genes and selfish DNA. DNA binding domains and motifs: Helix loop helix, Zinc finger, homeodomain, Leucine zippers.

Module 5: Regulation of gene expression:

Regulation of gene expression in prokaryotes and eukaryotes.The operon model - lactose, arabinose and tryptophan operon.Transposons - Types; Retroposons.Oncogenes.

Text Books

1. Friefelder, David. Molecular Biology.
2. Weaver, Robert F. Molecular Biology 2nd Edition, Tata McGraw-Hill,2003.
3. Karp, Gerald. Cell and Molecular Biology: Concepts and Experiments. 4th Edition, John Wiley, 2005.
4. Friefelder, David and George M. Malacinski. Essentials of Molecular Biology. 2nd Edition, Panima Publishing, 1993.
5. Lewin's GENES XI, Published by Jones & Bartlett Learning; 11 edition (January 15, 2013).

References:

1. Tropp, Burton E. Molecular Biology: Genes to Proteins. 3rd Edition, Jones and Bartlett, 2008.
2. Glick, B.R. and J.J. Pasternak. Molecular Biotechnology: Principles and Applications of Recombinant DNA; 4th Edition. ASM, 2010

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Chemistry of nucleic acids**	
1.1	Identification of the genetic material	2
1.2	Structure of DNA, different forms of DNA, C- value paradox.	2
1.3	Structure of RNA: mRNA, rRNA and tRNA - primary, secondary, tertiary structures and functions.	2
1.4	Central dogma of molecular biology; Chromosome organization in eukaryotes.	2
2	**DNA Replication**	
2.1	Models of DNA replication- Experimental evidence for the semi conservative mode.	2
2.2	Mechanism of DNA replication in *E.coli* (bidirectional) and Viral DNA (Rolling circle), Enzymes and Protein factors involved in replication.	2
2.3	Chromosomal replication of eukaryotes; Regulation of DNA replication.	2
2.4	Overview of mutations - Types of mutagens and mutations. Mechanisms of replication repair in prokaryotes and eukaryotes	4

3	**Transcription**	
3.1	RNA synthesis in prokaryotes and eukaryotes: Initiation, elongation and termination of RNA synthesis. Components of transcription machinery in prokaryotes and eukaryotes, Transcription factors.	4
3.2	Fidelity of RNA synthesis, Inhibitors of transcription.	1
3.3	Post transcriptional processing of RNA's- tRNA, rRNA, mRNA. Reverse transcription	2
4	**Translation**	
4.1	The genetic code, Wobble hypothesis and codon usage.	2
4.2	Protein synthesis in prokaryotes and eukaryotes, protein factors involved in protein synthesis, post translational modifications, inhibitors of translation.	4
4.3	Variants of gene- Split genes, Pseudogenes, Overlapping genes and selfish DNA. DNA binding domains and motifs: Helix loop helix, Zinc finger, homeodomain, Leucine zippers.	3
5	**Regulation of gene expression**	
5.1	Regulation of gene expression in prokaryotes and eukaryotes. The operon model - lactose, arabinose and tryptophan operon.	4
5.2	Transposons - Types; Retroposons.	2
5.3	Oncogenes	1

BTT307	THERMODYNAMICS AND HEAT TRANSFER	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: To understand the energy changes and heat transfer aspects which can be applied in industries

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply the laws of thermodynamics on biochemical reactions
CO 2	Comprehend the basic principles involved in the mechanism of heat transfer
CO 3	Evaluate the rate of heat transfer and area of heat transfer
CO 4	Analyze the performance of heat exchange equipments

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	-	2	2	-	-	-	-	-
CO2	3	2	2	2	-	2	2	-	-	-	-	-
CO3	3	3	2	3	-	3	2	-	-	-	-	-
CO4	3	3	2	3	-	3	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25
marks Assignment/Quiz/Course project	: 15
marks	

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Apply the laws of thermodynamics on biochemical reactions

1. What are the basic concepts of Thermodynamics?
2. What can Thermodynamic parameters tell us about Biochemical Events?
3. What are the characteristics of High energy Bio molecules?

- **Course Outcome 2 (CO2) :**Comprehend the basic principles involved in the mechanism of heat transfer

1. Distinguish between the conduction, convection and radiation modes of heat transfer
2. Illustrate the significance of Heat transfer in various fields of engineering
3. What is the difference between drop-wise and film condensation?

- **Course Outcome 3(CO3):**Evaluate the rate of heat transfer and area of heat transfer

1. Which is the feasible method for increasing the heat transfer rate? Write its principle?
2. How heat transfer coefficient can be found out? Identify any correlation that can be used in the case of laminar flow through a circular pipe
3. In a counter flow double pipe heat exchanger, 10000 Kg/hr of oil having a specific heat of 2095 J/Kg K is cooled from 80^0C to 50^0C by 8000 Kg/hr of water entering at 25^0C. Determine the heat exchanger area for an overall heat transfer co-efficient of 300 W/m^2K. Take Cp for water as 4180 J/KgK.

- **Course Outcome 4 (CO4):** Analyze the performance of heat exchange equipments

1. What are the advantages of compact heat exchangers over conventional type?
2. Explain constructional details and working principle of an industrial evaporator which is commonly used in concentrating black liquor in paper and pulp industries
3. Compare the performance of single and multiple effect evaporators

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:___________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE EXAMINATION_____________20_

Course Code: BTT 307

Course Name: THERMODYNAMICS AND HEAT TRANSFER

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	(a)	What are the limitations of first law of thermodynamics?
	(b)	How free energy, enthalpy and entropy is related in biological systems
	(c)	How will you fix the thickness for insulation materials?
	(d)	What is Lumped Capacity Analysis?
	(e)	What is Dittus-Boelter equation and when is it applied?
	(f)	Write the concept of Boundary layer
	(g)	Write an empirical correlation for calculating heat flux in nucleate boiling
	(h)	What is Blackbody radiation?
	(i)	Write the material and energy balance equations for a single effect evaporator
	(j)	How heat exchangers are classified?

PART B

Answer any one full question from each module. Each carries 14 marks.

2	(a)	Write the Second law of thermodynamics	(6)
	(b)	Explain the free energy changes in hydrolysis of ATP	(8)
		OR	
3		Explain how a thermodynamically unfavorable (endergonic) reaction can be converted to a highly exergonic reaction by taking any example	(14)
4		Develop the expression for steady state one-dimensional heat flow through a plane wall with and without heat generation	(14)
		OR	

5		Establish the general heat conduction equation for rectangular co-ordinate system for three- dimensional unsteady heat conduction with internal heat generation by considering an infinitesimal volume element. Get the reduced form of heat equation for the following cases (i)unsteady state two-dimensional flow with heat generation at uniform rate within the material (ii) steady state one-dimensional flow without heat generation	(14)
6		How overall heat transfer co-efficient is related to individual heat transfer co-efficient in the case of heat transfer between fluids separated by a cylindrical wall	(14)
		OR	
7		How overall heat transfer co-efficient is related to individual heat transfer co-efficient in the case of heat transfer between fluids separated by a cylindrical wall	(14)
8		Develop Nusselt Model for film condensation on a vertical plate stating all the assumptions	(14)
		OR	
9		Write the laws governing in Radiation heat transfer	(14)
10		Recommend en evaporator for concentrating a corrosive solution. Give justification for your answer. Also draw the constructional details of the same.	(14)
		OR	
11		With a neat diagram, elucidate the constructional details and working principle of a SHE	(14)
****			

Syllabus

Module 1: Fundamentals of Thermodynamics & Bioenergetics

Scope of Thermodynamics, Thermodynamic Systems- Closed, open and isolated system - reversible and irreversible process –Zeroth law of Thermodynamics- First Law of Thermodynamics- Limitations of First Law-Second Law of Thermodynamics- Definition of Entropy- Third law of Thermodynamics.
Energy changes in living systems – free energy, enthalpy, entropy and their relationship, free energy changes in biochemical reactions such as hydrolysis of ATP and other high energy phosphate compounds, application of calorimetry to gain basic understanding of energy flow in a biological system, Effect pH and concentration on net free energy changes.

Module 2: Heat Transfer - Basic Concepts

Mechanism of different modes of heat transfer viz. Conduction, Convection and Radiation & various applications. General heat conduction equation in various coordinates, Formulation of heat transfer problems using different boundary conditions with and without heat generation. Insulation materials and Fins. Introduction to unsteady state heat conduction-Lumped capacity analysis. Numerical problems

Module 3: Convective Heat Transfer

Newton's law of cooling, Dimensional analysis applied to forced and free convection, Buckingham's pi theorem, dimensionless numbers and their physical significance, empirical correlations for free and forced convection. Individual and overall heat transfer coefficient. Heat transfer between fluids separated by a flat solid wall. Heat transfer between fluids separated by a cylindrical wall. Thermal and hydrodynamic boundary layer. Numerical problems

Module 4: Heat Transfer in Boiling and Condensation

Boiling heat transfer- Regimes of pool boiling of saturated liquid .Correlations for estimating the boiling heat transfer coefficients. Types of condensation. Nusselt's equation with derivation. Correlations for determination of condensing coefficients.
Radiation Heat Transfer: Basic definition pertaining to radiation, Blackbody radiation, Planck's law, Wien's law, Stefan-Boltzmann law & Kirchhoff's law, Grey body concept.

Module 5: Heat Exchangers & Evaporators

Detailed classification of heat exchangers: elementary design of Double pipe & Shell and tube heat exchangers. Use of Non-compact heat exchangers. LMTD, LMTD correction factor. Types of evaporators and theory: Natural & forced circulation evaporators, Performance of steam heated tubular evaporators, Single & Multiple effect evaporators. Method of feeding in multiple effect evaporators. (No numerical problems are expected from this module. Only qualitative treatment and derivations required)

Text Books

1. Narayanan K. V., A Textbook of Chemical Engineering Thermodynamics, 2nd Edn., Prentice-Hall of India, 2013
2. Dutta B. K., *Heat Transfer- Principles and Applications*, Prentice Hall of India, 2000

Reference Books

1. Holman J. P., *Heat Transfer*, McGraw Hill, 1992.
2. Coulson J. M. and J. F. Richardson, *Chemical Engineering,* Vol. 1, Pergamon Press, 1999.
3. K. A. Gavhane, *Hear Transfer*, Nirali Prakashan, 2008
4. Doran P. M., *Bioprocess Engineering Principles*, 2/e, Elsevier- Academic Press, 2013.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Fundamentals of Thermodynamics & Bioenergetics**	
1.1	Scope of Thermodynamics, Thermodynamic Systems- Closed, open and isolated system - reversible and irreversible process	2
1.2	Zeroth law of Thermodynamics- First Law of Thermodynamics- Limitations of First Law-Second Law of Thermodynamics- Definition of Entropy- Third law of Thermodynamics	2
1.3	Energy changes in living systems – free energy, enthalpy, entropy and their relationship	2
1.4	free energy changes in biochemical reactions such as hydrolysis of ATP and other high energy phosphate compounds, application of calorimetry to gain basic understanding of energy flow in a biological system, Effect pH and concentration on net free energy changes.	4
2	**Heat Transfer - Basic Concepts**	
2.1	Mechanism of different modes of heat transfer viz. Conduction, Convection and Radiation & various applications.	2
2.2	General heat conduction equation in various coordinates, Formulation of heat transfer problems using different boundary conditions with and without heat generation.	3
2.3	Insulation materials and Fins. Introduction to unsteady state heat conduction- Lumped capacity analysis	3
2.4	Numerical problems	2
3	**Convective Heat Transfer**	
3.1	Newton's law of cooling, Dimensional analysis applied to forced and free convection- Buckingham's pi theorem , dimensionless numbers and their physical significance, empirical correlations for free and forced convection	4
3.2	Individual and overall heat transfer coefficient. Heat transfer between fluids separated by a flat solid wall. Heat transfer between fluids separated by a cylindrical wall.	3
3.3	Thermal and hydrodynamic boundary layer.	1
3.4	Numerical problems	2
4	**Heat Transfer in Boiling and Condensation**	
4.1	Boiling heat transfer- Regimes of pool boiling of saturated liquid. Correlations for estimating the boiling heat transfer coefficients.	2
4.2	Types of condensation. Nusselt's equation with derivation.	3

	Correlations for determination of condensing coefficients.	
4.3	Basic definition pertaining to radiation, Blackbody radiation, Planck’s law, Wien’s law, Stefan-Boltzmann law & Kirchhoff’s law, Grey body concept.	3
5	**Heat Exchangers & Evaporators**	
5.1	Detailed classification of heat exchangers	1
5.2	Elementary design of Double pipe & Shell and tube heat exchangers. Use of Non-compact heat exchangers. LMTD, LMTD correction factor	3
5.3	Types of evaporators and theory: Natural & forced circulation evaporators,	3
5.4	Performance of steam heated tubular evaporators, Single & Multiple effect evaporators. Method of feeding in Multiple effect evaporators	2

BTL331	BIOPROCESS ENGINEERING LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: Bioprocess engineering is an integral part of Biotechnology which is essential for the production of Biomolecules in large quantities

Prerequisite: Bioprocess Calculation of S3 Semester

Course Outcomes: After the completion of the course the student will be able to

CO 1	Development of an ability to design and conduct bioprocess experiments as well as to analyze and interpret data.
CO 2	Calculate the kinetic parameters of enzymatic reactions as well as microbial growth
CO 3	Development of research attitude and technical skills to secure a job in bioprocess labs.
CO 4	Exhibit ethical principles in the engineering profession by practicing ethical approaches in experimental investigation, collection and reporting of data and adhering to the relevant safety practices in the laboratory.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	-	3	2	-	-	3	3	3	3	-
CO2	3	3	-	3	-	-	-	-	-	-	-	-
CO3	3	3	-	3	2	-	-	3	3	3	-	3
CO4	3	3	-	3	-	-	-	3	-	-	3	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting: 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1): Development of an ability to design and conduct bioprocess experiments as well as to analyze and interpret data

1. Determine the growth pattern of E.coli.
2. Formulation of simple and complex culture media.
3. Medium Optimization by Plackett Burman Design and Response Surface Methodology

Course Outcome 2 (CO2): Calculate the kinetic parameters of enzymatic reactions as well as microbial growth

1. Determination of Kinetics of growth in batch culture - Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
2. Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.
3. Study of kinetics of enzyme catalyzed reaction- Determination of Michaelis – Menten parameters

Course Outcome 3(CO3): Development of research attitude and technical skills to secure a job in bioprocess labs

1. Determination of Effect of Temperature on enzyme activity and Deactivation Kinetics
2. Effect of pH on enzyme activity
3. Kinetics of enzyme inhibition

Course Outcome 4 (CO4): Exhibit ethical principles in the engineering profession by practicing ethical approaches in experimental investigation, collection and reporting of data and adhering to the relevant safety practices in the laboratory

1. Molecular weight determination of enzyme by Gel filtration method.
2. Bioconversion studies with immobilized enzyme reactors.
3. Demonstration of stirred tank bioreactor system, various parts and process control systems.

Syllabus

A minimum of 12 Experiments is mandatory

1. Determine the growth pattern of E.coli.
2. Formulation of simple and complex culture media.
3. Medium Optimization by PlackettBurman Design and Response Surface Methodology
4. Determination of Kinetics of growth in batch culture - Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient
5. Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.
6. Estimation of KLa – Sulphite Oxidation Method
7. Enzyme isolation and assay- quantification of enzyme activity and specific activity
8. Study of kinetics of enzyme catalysed reaction- Determination of Michaelis – Menteen parameters
9. Determination of Effect of Temperature on enzyme activity and Deactivation Kinetics
10. Effect of pH on enzyme activity
11. Kinetics of enzyme inhibition
12. Enzyme immobilization – Gel entrapment
13. Molecular weight determination of enzyme by Gel filtration method.
14. Bioconversion studies with immobilized enzyme reactors.
15. Demonstration of stirred tank bioreactor system, various parts and process control systems.

Text Books

1. Weith, John W.F., Biochemical Engineering – Kinetics, Mass Transport, Reactors and Gene Expression, Wiley and Sons Inc. (1994).

2. Bailey, J.E. and Ollis, D.F, Biochemical Engineering Fundamentals, McGraw Hill, New York (1986)
3. Doran, P.M Bioprocess Engineering Principles, Academic Press (2012)
4. Aiba, S., Humphrey, A.E and Millis, N.F., Biochemical Engineering, Academic Press (1973)

Reference Books

1. Stanbury P. F., Whittaker, A. and Hall, S. J., Principles of Fermentation Technology, Butterworth-Heinemann (2007).
2. Shuler M., Kargi F., Bioprocess Engineering: Basic Concepts, PHI (2012).

Course Contents and Lecture Schedule

No	Topic	No. of hours
1	Determine the growth pattern of E.coli.	3
2	Formulation of simple and complex culture media.	3
3	Determination of Kinetics of growth in batch culture - Estimation of Biomass, Calculation of Specific Growth Rate, Yield Coefficient	3
4	Medium Optimization by PlackettBurman Design and Response Surface Methodology	3
5	Temperature effect on growth-estimation of energy of activation and Arrhenius Constant for microorganisms.	3
6	Estimation of KLa – Sulphite Oxidation Method	3
7	Enzyme isolation and assay- quantification of enzyme activity and specific activity	3
8	Study of kinetics of enzyme catalysed reaction- Determination of Michaelis – Menten parameters	3
9	Determination of Effect of Temperature on enzyme activity and Deactivation Kinetics	3
10	Effect of pH on enzyme activity	3
11	Kinetics of enzyme inhibition	3
12	Enzyme immobilization – Gel entrapment	3
13	Molecular weight determination of enzyme by Gel filtration method.	3
14	Bioconversion studies with immobilised enzyme reactors.	3
15	Demonstration of stirred tank bioreactor system, various parts and process control systems.	3

BTL333	MOLECULAR BIOLOGY LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:

1. Provide hands-on experience in performing basic molecular biology techniques.
2. This will facilitate the students to take up specialized project in Molecular Biology which is pre-requisite for molecular biology based research work.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate knowledge and understanding of the principles behind the important techniques in molecular biology.
CO 2	Apply the knowledge in understanding the applications of the techniques in molecular biology.
CO 3	Analyze and interpret the results of the laboratory experiments performed.
CO 4	Exhibit the awareness of the hazardous chemicals and safety precautions in case of emergency.

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	3	-	3	2	-	-	-	3	3	-	-
CO2	3	3	-	3	2	-	-	-	3	3	-	-
CO3	-	-	-	2	-	-	-	-	3	3	3	2
CO4	-	-	-	3	-	3	3	2	3	3	-	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipment and troubleshooting) : 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1): Demonstrate knowledge and understanding of the principles behind the important techniques in molecular biology.

1. Explain the importance of buffers in electrophoresis
2. Elaborate on the plasmid isolation methodology
3. How is antibiotic sensitivity used in screening recombinants?

Course Outcome 2 (CO2): Apply the knowledge in understanding the applications of the techniques in molecular biology

1. Explain the application of SDS PAGE.
2. How does quality of plasmid DNA isolated affect the restriction digestion process?
3. What are the applications of PCR?

Course Outcome 3(CO3): Analyze and interpret the results of the laboratory experiments performed.

1. What are the causes of shearing while isolating plasmid DNA?
2. Analyse the factors responsible for absence of transformants after plating.
3. Analyse the presence of multiple bands in PCR for a single set of primer used.

Course Outcome 4 (CO4): Exhibit the awareness of the hazardous chemicals and safety precautions in case of emergency.

1. Enumerate the hazardous chemicals used in electrophoresis
2. What are the safety precautions to be followed while doing electrophoresis?
3. What is the appropriate method to discard used reagents in the laboratory?

Syllabus

A minimum of 10 Experiments is mandatory

1. Electrophoresis - Agarose and Polyacrylamide Gel
2. Isolation of Prokaryotic DNA
3. Isolation of plasmid DNA
4. Isolation of eukaryotic genomic DNA
5. Quantification of DNA (UV/ Vis) and analysis of purity
6. Restriction enzyme digestion& Ligation
7. Competent cells preparation
8. Transformation
9. Selection of recombinants
10. Polymerase Chain Reaction (PCR
11. Plating of A phage
12. Lamda phage lysis of liquid cultures
13. Blotting techniques

Text Books

1. Sambrook, Joseph and David W. Russell,The Condensed Protocols: From Molecular Cloning: A Laboratory Manual Cold Spring Harbor, 2006.

Reference Books

1. Karp, Gerald. Cell and Molecular Biology: Concepts and Experiments. 4th Edition, John Wiley, 2005.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1.	Electrophoresis - Agarose gel	3
2.	Polyacrylamide Gel Electrophoresis	3
3.	Isolation of Prokaryotic DNA	3
4.	Isolation of plasmid DNA	3
5.	Isolation of eukaryotic genomic DNA	3
6.	Quantification of DNA (UV/ Vis) and analysis of purity	3
7.	Restriction enzyme digestion& Ligation	3
8.	Competent cells preparation	3
9.	Transformation	3
10.	Selection of recombinants	3
11.	Polymerase Chain Reaction (PCR)	3
12.	Plating of a phage	3
13.	Lamda phage lysis of liquid cultures	3
14.	Blotting techniques	3

SEMESTER V

MINOR

BTT381	PURIFICATION OF BIOMOLECULES	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: The course requires an understanding of the biomolecules that are important for maintaining life and its functions

Prerequisite: Basics in Bioprocess engineering

Course Outcomes: After the completion of the course the student will be able to

CO 1	Describe the principles that underlie major unit operations used in downstream processing of biotechnological and biopharmaceuticals
CO 2	Define and analyze different terms in downstream process and understand separation and purification of fermentation products
CO 3	Integrate biological and engineering principles involved in the production and recovery of commercial products.
CO 4	Demonstrate the principles behind final purification of bioproducts.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	-	-	-	-	-	-	3	-	-
CO4	3	3	3	-	3	-	-	-	-	3	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Describe the principles that underlie major unit operations used in downstream processing of biotechnological and biopharmaceuticals

1. Discuss about the problems and requirements of bioproduct purification.
2. Distinguish between high volume low value products and low volume high value products.
3. Outline the general layout of bioproduct purification.

Course Outcome 2 (CO2) : Define and analyze different terms in downstream process and understand separation and purification of fermentation products

1. Explain the principle of any two physical method of cell disruption.
2. Explain the principle of flocculation.
3. Write note on electrical double layer concept.

Course Outcome 3(CO3): Integrate biological and engineering principles involved in the production and recovery of commercial products.

1 Brief about different types of filter media used in filtration process.
1. 2. Write a short note on Isopycnic sedimentation.
2. Describe the factors affecting membrane based separation process.

Course Outcome 4 (CO4): Demonstrate the principles behind final purification of bioproducts.

1. Discuss about salting in and salting out of proteins
2. Explain the principle of aqueous two phase extraction.
3. Outline the theory of nucleation.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE(MINORS) EXAMINATION ________ ____ 20__

Course Code: BTT 381

Course Name: PURIFICATION OF BIOMOLECULES

Max. Marks: 100	Duration: 3 Hours

Answer all questions, each carries 3 marks.

		Answer all questions, each carries 3 marks.
1	a)	Write a short note on characteristics of fermentation broth.
	b)	Discuss about the need for downstream processing.
	c)	Explain the theory of charge dependent flocculation.
	d)	Explain the enzymatic methods of cell disruption.
	e)	Explain Darcy's law.
	f)	Discuss about ultracentrifugation.
	g)	Elaborate on reversed miscellar extraction.
	h)	Explain the principle of Ion exchange chromatography.
	i)	Enumerate three applications of crystallisation.
	j)	List out three applications of spray drying.

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Illustrate the problems and requirements of bio product purification, discuss on the economics & cost cutting strategies	(14)
		OR	
3		With a neat flow diagram explain the isolation and purification steps involved in the production of a pharmaceutical product.	(14)
4		Discuss the different physicochemical methods for cell disruption.	(14)
		OR	

5		Explain the principle and process of flocculation.	(14)
6		Describe the working of continuous rotary drum filter with a neat sketch.	(14)
		OR	
7		Explain the different types of membrane based separation process.	(14)
8		Write notes on i) organic solvent mediated precipitation ii) Supercritical fluid extraction.	(14)
		OR	
9		What is the theory of Gel filtrationchromatography? Explain with a neat sketch.	(14)
10		Discuss about the purification of citric acid with a neat diagram.	(14)
		OR	
11		Brief about the types of driers.	(14)
		****	

Syllabus

Module 1

Problems and requirements of bio product purification Economics & Cost cutting strategies, Introduction to high volume, low value products and low volume, high value products, Need for downstream processing, Characteristics of fermentation broth, General account of downstream processing steps: removal of insoluble, cell disruption, isolation, product purification and product formulation

Module 2

Cell disruption techniques: Analysis of various physical methods- thermolysis, osmotic shock, ultrasonication; chemical methods- alkali treatment, detergent solubilization, cell wall permeabilization; enzymatic methods and mechanical methods – bead mill disruption, high pressure homogenizer**. Flocculation:** Importance in downstream processing, electrical double layer concept, DLVO theory, mechanisms of charge dependent flocculation.

Module 3

Filtration techniques: filter media, pre-treatment methods, general filtration theory-Darcy's law, compressible and incompressible filter cakes, filtration cycle, continuous rotary drum filters. **Centrifugation:** Theory of centrifugal settling-basic equations, Sedimentation coefficient,Isopycnicsedimentation,ultra centrifugation.

Membrane Based Separations: Classification of membrane separation process, factors affecting separation process, microfiltration, ultrafiltration, reverse osmosis, dialysis, electro dialysis

Module 4

Precipitation: Precipitation methods- isoelectric precipitation, salting out, organic solvent mediated precipitation and precipitation bynon-ionic polymers. **Extraction**: Extraction principles, aqueous two-phase extraction, reversed micellar extraction, supercritical fluid extraction. **Chromatographic purification:** basic concepts and principles, gel filtration, Ion exchange,affinity chromatography

Module 5

Crystallization: Theory – nucleation, crystal growth, process crystallization of proteins, recrystallization. **Drying:** drying principles, heat and mass transfer in drying, types of dryers- vacuumdryer, freeze dryer spray dryer. Modern strategies in Downstream Processing,

Case studies involved in the downstream processing of Ethanol, Citric acid

Text Books

1 Paul A Belter, EL Cussler, Wei-shou Hu, Bioseparations: Downstream Processing for Biotechnology- Wiley Interscience, 1988.
2 Sivasankar B, *Bioseparations: Principles and Techniques*, Prentice-Hall of India Pvt. Ltd., 2008.

Reference Books

1 Harrison RG, Todd P, Rudge SR, Petrides DP, *Bioseparations Science and Engineering*, Oxford Press, 2003.
2 Richard W Baker, *Membrane Technology and applications*, John Wiley & Sons Ltd., 2004.
3 McCabe, WL, Smith JC, Harriott P, *Unit Operation of Chemical Engineering*, 6/e, McGraw Hill, New York, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Problems and requirements of bio product purification**	
1.1	Role and importance of downstream processing in biotechnological processes, Problems and requirements of bio product purification, Economics & Cost cutting strategies, Introduction to high volume, low value products and low volume, high value products	4
1.2	Need for downstream processing, Characteristics of fermentation	2

	broth	
1.3	General account of downstream processing steps: removal of insoluble, cell disruption, isolation, product purification and product formulation	2
2	**Cell disruption techniques**	
2.1	Analysis of various physical methods- thermolysis, osmotic shock, ultra-sonication; chemical methods- alkali treatment, detergent solubilization, cell wall permeabilization	3
2.2	Enzymatic methods and mechanical methods – bead mill disruption, high pressure homogenizer.	3
2.3	**Flocculation:** Importance in downstream processing, electrical double layer concept, DLVO theory, mechanisms of charge dependent flocculation.	3
3	**Filtration techniques, Centrifugation and membrane based methods**	
3.1	filter media, pre-treatment methods, general filtration theory- Darcy's law, compressible and incompressible filter cakes	2
3.2	Filtration cycle, continuous rotary drum filters.	2
3.3	Theory of centrifugal settling-basic equations, Sedimentation coefficient,Isopycnicsedimentation, ultra centrifugation.	3
3.4	Classification of membrane separation process, factors affecting separation process, microfiltration, ultrafiltration, reverse osmosis, dialysis, electro dialysis	3
4	**Precipitation, Extraction and Chromatographic purification**	
4.1	Precipitation methods- isoelectric precipitation, salting out, organic solvent mediated precipitation and precipitation bynon-ionic polymers.	3
4.2	Extraction principles, aqueous two-phase extraction, reversed micellar extraction, supercritical fluid extraction.	3
4.3	Basic concepts and principles, gel filtration, Ion exchange,affinity chromatography	3
5	**Crystallization and Drying**	
5.1	Theory – nucleation, crystal growth, process crystallization of proteins, recrystallization.	3
5.2	**Drying:** drying principles, heat and mass transfer in drying, types of dryers-vacuum dryer, freeze dryer spray dryer. Modern strategies in Downstream Processing	3
5.3	Case studies involved in the downstream processing of Ethanol, Citric acid	3

BTT383	BIOINFORMATICS & GENOMICS TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Introduction to sequencing, mapping; biological databases;sequence analysis

Prerequisite: Basic knowledge in molecular biology, internet basics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Summarize the genomics and proteomics techniques so as to apply in solving research problems.
CO 2	Access the appropriate biological database so as to develop solutions for various research problems
CO 3	Apply different bioinformatics tools for sequence analysis and practice the modern tools for future independent use.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1			2	2	-	-	-	-	-	-	-	-
CO 2			2	2	2	-	-	-	-	-	-	-
CO 3			2	2	3	-	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Summarize the genomics and proteomics techniques so as to apply in solving research problems

1. Which are the different types of physical mapping techniques?
2. Which are the different types of SNPs?
3. Narrate the goals of Human Genome Project?

Course Outcome 2 (CO2): Access the appropriate biological database so as to develop solutions for various research problems

1. Which are the different databases available to fetch a protein sequence?
2. Point out the major advantage of Entrez retrieval system?
3. Explain the different in silico approaches that can be used to identify an unknown protein sequence.

Course Outcome 3(CO3): Apply different bioinformatics tools for sequence analysis and practice the modern tools for future independent use

1. Differentiate between Phylogram and Cladogram.
2. What do you infer when two protein sequences have 60% identity?
3. Which are the different methods for Multiple Sequence Alignment?

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE(MINORS) EXAMINATION ________ ____ 20__

Course Code: BTT383

Course Name: BIOINFORMATICS AND GENOMICS TECHNOLOGY

Max. Marks: 100	Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Which are the different types of sequence repeats?
	b)	Explain about RFLPS.
	c)	What are SNPs? Give example.
	d)	What is the principle behind Sanger Dideoxy method?
	e)	What is FASTA format? Give example.
	f)	List out the major protein family databases.
	g)	Differentiate PAM and BLOSUM matrices.
	h)	Name any 6 BLAST variants.
	i)	What is Clustal W used for? What does W indicate?
	j)	Explain about any 6 applications of multiple sequence alignment.

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Explain about the Human Genome Project. Which were the techniques employed for deciphering the entire genome.	(14)
		OR	
3		Explain in detail about the different physical and genetic techniques used in genome mapping.	(14)
4		Differentiate the merits and demerits of basic and automated methods of DNA sequencing.	(14)
		OR	
5		Point out the different steps in a microarray experiment.	(14)
6		How are biological databases classified? Explain in detail about each database.	(14)

		OR	
7		Point out the different bioinformatics tools and repositories that can be used to explore more about the biological data.	(14)
8		Explain about the working of BLAST algorithm? Which are the different variants of BLAST?	(14)
		OR	
9		Differentiate between Local and Global alignment methods with example.	(14)
10		Briefly explain about the applications of Multiple Sequence Alignment. Illustrate with an example explain about the construction of a phylogenetic tree using distance based method.	(14)
		OR	
11		List out the steps in phylogenetic tree construction in detail.	(14)
		****	

Syllabus

Module 1:

Introduction to genomics: prokaryotic, eukaryotic and archae genomes, repetitive DNA, Genetic and Physical map of genomes, Sequence and genome assembly.

Module 2:

Methods of preparing genomic DNA, DNA sequence analysis methods: Sanger Dideoxy method and Fluorescence method, Gene variation and Single Nucleotide Polymorphisms (SNPs), Expressed sequenced tags (ESTs),cDNA microarray technology

Module 3:

Introduction to Bioinformatics: Scope and Applications of Bioinformatics. Biological databases and their classification (Primary, Secondary and Relational databases), File formats.Information retrieval from Biological Databases (ENTREZ and SRS); Sequence Databases (EMBL, GenBank, DDBJ, SWISS-PROT, PIR, TrEMBL), EST databases; SNP databases; Protein Family/Domain Databases (PROSITE, Pfam, PRINTS & SMART), & Structural Database (PDB, MMDB and CSD).

Module 4:

Sequence analysis:, reading protein and DNA sequences in right way, palindromes in DNA sequences, RNA structures, genetic codes, Heterologs, Orthologs, Paralogs, Xenologs, Comparing two sequences: Identity vs. Similarity, local and global alignment, Dot matrix, Dynamic programing, Substitution matrices (Identity, PAM and BLOSSUM), Database

Similarity Search using BLAST and FASTA, algorithm of BLAST and FASTA, PSI-BLAST, PHI-BLAST, Statistical and Biological significance.

Module 5:

Multiple Sequence Alignment: Methods of MSA, Basics of Molecular Evolution and Molecular Phylogenetics, Introduction to methods and applications of Phylogenetic tree construction, various phylogenetic tree representations: Dendrogram, Cladogram, Phylogram, and Chronogram. Multiple Sequence alignment and applications:: Uses; Methods available- Iterative alignment, Progressive alignment – ClustalW, T-Coffee.

Text Books

1. Baxevanis A D, Francis Ouellellette B F, *Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins*, Wiley Interscience,2009.

Reference Books

2. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley 2006
3. Brown TA, Genomes, 3rd Edition. Garland Science 2006
4. Campbell AM &Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1.1	Human genome project	1
1.2	Physical mapping	3
1.3	Genetic mapping	2
1.4	Sequence repeats	1
1.5	Sequence assembly	1
2.1	Methods of preparing genomic DNA	1
2.2	Sangers method	1
2.3	Automated sequencing	2
2.4	SNPs	1
2.5	ESTs	1
2.6	cDNA microarray technology	3
3.1	Introduction, Applications of Bioinformatics	2
3.2	Biological Databases classification	2
3.3	Sequence databases	2
3.4	Structure databases	2
3.5	Family databases	2
3.6	EST, SNP databases	1
4.1	Sequence analysis Sequence analysis:, reading protein and DNA sequences in right way, palindromes in DNA sequences	1

4.2	Heterologs, Orthologs, Paralogs, Xenologs, Comparing two sequences: Identity vs. Similarity	1
4.2	BLAST	1
4.3	FASTA	1
4.4	PAM,BLOSUM	1
4.5	Local and global alignment, Dot matrix, Dynamic programing	2
5.1	MSA applications	1
5.2	Methods of MSA- Iterative alignment, Progressive alignment – ClustalW, T-Coffee.	2
5.3	Basics of Molecular Evolution and Molecular Phylogenetics	1
5.4	phylogenetic tree representations: Dendrogram, Cladogram, Phylogram, and Chronogram	1
5.5	Introduction to methods and applications of Phylogenetic tree construction	3

BTT385	INDUSTRIAL SAFETY MANAGEMENT	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Enhance knowledge safety and risk assessment in a bioprocess industry

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the significance of safety management in chemical and bioprocess industries
CO 2	Identify the key hazards and risks associated with various industrial processes and recommend appropriate control measures and safety procedures.
CO 3	Understand the relevance of “design for safety” concept in process industries and outline various engineering principles and methods relevant to safety management

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	2	-	2	-	-	-	-
CO3	3	-	3	-	-	2	-	-	-	-	-	-

Assessment Pattern

Bloom’s Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the significance of safety management in chemical and bioprocess industries

1. List the sources of fire and inhalation hazards in refineries.
2. Describe the control measures taken to ensure safety on electrical hazards
3. Explain Maharashtra Safety Officers Rule-1982

Course Outcome 2 (CO2): Identify the key hazards and risks associated with various industrial processes and recommend appropriate control measures and safety procedures

1. Discuss the role of pressure relieving system in controlling hazards in an industry
2. What are the safety measures to be taken in the case of processes involving gases and vapours?
3. Explain in detail about the technical and engineering control measures to improve the workplace design

Course Outcome 3(CO3): Understand the relevance of “design for safety” concept in process industries and outline various engineering principles and methods relevant to safety management

1. Differentiate four levels of containment
2. Short note on Biosafety Guidelines in India

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE(MINORS) EXAMINATION ________ ____ 20__

Course Code: BTT 385

Course Name: INDUSTRIAL SAFETY MANAGEMENT

Max. Marks: 100	Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1	a)	Explain the concept & philosophy of Safety
	b)	What are the different forms of creating awareness about safety among the employees?
	c)	Improving safety and productivity can be done through work place design and control measures. Elaborate three reasons to justify the statement.
	d)	What is preventive maintenance? Explain its importance.
	e)	Explain in detail about the technical and engineering control measures to improve the workplace design
	f)	Differentiate between safety training and safety education.
	g)	Discuss the Concept of workplace and its design
	h)	Classify the various Occupation Health Hazards
	i)	What is biosafety management
	j)	Classify microorganisms based on containment levels

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Explain Maharashtra Safety Officers Rule-1982	(10)
	b)	Describe the control measures taken to ensure safety on electrical hazards	(4)
		OR	
	b)	Write in detail about Public Liabilities Insurance Act-1991	(14)
4	a)	What are physical hazards? Describe the methods to control	(10)
	b)	Explain the Risks associated with large scale industrial processes	(4)
		OR	
5	a)	Short note inhalation on inhalation hazards due to various industrial	(10)

		operations.	
	b)	List the control measures in limiting emissions from an industry	(4)
6		Differentiate between incident and accident. What is the purpose of reporting of accidents and incidents? Explain the role of a safety officer in an industry	(14)
		OR	
7		Define Occupational health hazards. List the different types of such hazards.	(14)
8		Explain in detail,the biosafety consideration for biological expression system	(14)
		OR	
9	a)	Discuss classification of organisms based on risks for laboratory workers and the environment	(10)
	b)	Outline the risk groups and bio safety level	(4)
10	a)	Write a note on bio safety guidelines.	(10)
	b)	Discuss spill protocols and waste disposal precautions and methods, regulatory compliance and containment	(4)
		OR	
11		What are the advantages and disadvantages of genetically modified organism? How it will affect the environment	(14)
****			

Syllabus:

Module 1

Overview of Industrial safety: Safety concept, environmental and occupational diseases, repetitive stress injury, ergonomics, safety regulations, laws and agencies, pollution issues.

Hazards in chemical process industries: General terminology, hazards associated with specific industries- polymer production, rubber products manufacturing industry, sulfuric acid and phosphoric acid manufacturing, insecticide manufacture

Module 2

Hazards in refineries: Sources of fire and inhalation hazards in refineries, engineering control methods, hazardous properties of organic materials, flammability of hydrocarbons. Engineering controls for limiting emissions- Pressure relieving systems (safety valves, rupture discs and flares); inhalation hazards from tanker operations, oil-water effluent systems, air emissions from valves, cooling tower operations, miscellaneous air emissions (turnarounds, tank cleaning, vacuum jets and compressor engine exhausts)

Module 3

Industrial safety management: Techniques of safety management- safety programming; safety procedures, arrangements and performance measures; education, training and development in safety. Safety performance planning- Accident, injury and incident; Occupational health and industrial hygiene, emergency preparedness and response. Exercises in safety management- Investigation and prevention, safety systems, safeguarding against common potential hazards.Specific hazard control measures, safe handling and storage.Accident case studies and case histories.

Module 4

Safety in the bioprocess industry: Safety in microbiology- laboratory and industry associated infections and their routes; Hazard groups and containment categories- systems of classification of microorganisms based on hazard, containment categories- barrier system, containment levels.

Risk assessment in the bioprocess industry: Methods for reducing risk (physical and biological containment, safe performance of techniques), levels of containment in biotechnology; Risks associated with large scale industrial processes- escape of microorganisms- risks to personnel and the environment; Risks associated with fermentations under higher levels of containment (LS1, LS2 and LS3 levels); Risks by accidents (breakage and leakage) at various containment levels; Assessment of risks associated with biomass and open fermentations.

Module 5

Engineering for safe bio-processing: Good industrial large scale practice (GILSP), containment features; Design for safety- facility design, bioreactors and process engineering.

Containment in the manufacture of rDNA-derived products: Safety precautions and containment categories, general principles of primary and secondary containment.

Monitoring and validation in biotechnological processes: Importance of detection of air and surface contamination- methods for detection and enumeration of air and surface contaminants. Monitoring of large scale and pilot-plant operations, controlling improvements in containment, validation of air filters.

Text books:

1. L.M. Deshmukh*Industrial safety management- Hazard identification and risk control*, Tata McGraw Hill (2005).

2. Nicholas. P. Chermisinoff*Practical guide to industrial safety- Methods for safety process professionals*, Marcel Dekker (2001).
3. C.H.Collins and A.J.Beale (eds.) *Safety in industrial Microbiology and Biotechnology* Butterworth Heinemann (1992).

Reference books:

1. NaseerElahi *Industrial safety management, Kalpaz publications, 2006.*
2. Laird Wilson, Doug McCutcheon & Marilyn Buchanan *Industrial safety and risk management*, University of Alberta Press, 2003.
3. C. Ray Asfahl, David W. Rieske*Industrial safety and health management*, Prentice Hall, 2010.
4. N.V. Krishnan *Safety management in the industry*, Jaico Publishing House, 1996.
5. Jack.E.Daugherty*Industrial safety management: A practical approach*, Government institutes, 1999.
6. Warren C. Hyer*Bioprocessing Safety: Worker and Community Safety and Health Considerations* (Issue 1051), ASTM, 1990.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Safety and Hazards**	
1.1	**Overview of Industrial safety:** Safety concept, environmental and occupational diseases, repetitive stress injury, ergonomics, safety regulations, laws and agencies, pollution issues.	3
1.2	**Hazards in chemical process industries**: General terminology, hazards associated with specific industries- polymer production, rubber products manufacturing industry, sulphuric acid and phosphoric acid manufacturing, insecticide manufacture	5
2	**Hazards in refineries**:	
2.1	Sources of fire and inhalation hazards in refineries, engineering control methods, hazardous properties of organic materials, flammability of hydrocarbons. Engineering controls for limiting emissions	4
2.2	Pressure relieving systems (safety valves, rupture discs and flares);	2
2.3	Inhalation hazards from tanker operations, oil-water effluent systems, air emissions from valves, cooling tower operations, miscellaneous air emissions (turnarounds, tank cleaning, vacuum jets and compressor engine exhausts)	3

3	**Industrial safety management**	
3.1	Techniques of safety management- safety programming; safety procedures, arrangements and performance measures; education, training and development in safety.	4
3.2	Safety performance planning- Accident, injury and incident; Occupational health and industrial hygiene, emergency preparedness and response.	3
3.3	Exercises in safety management- Investigation and prevention, safety systems, safeguarding against common potential hazards. Specific hazard control measures, safe handling and storage. Accident case studies and case histories.	3
4	**Safety and Risk assessment in bioprocess industry**	
4.1	**Safety in the bioprocess industry**: Safety in microbiology- laboratory and industry associated infections and theirroutes; Hazard groups and containment categories- systems of classification of microorganisms based on hazard, containment categories- barrier system, containment levels.	4
4.2	**Risk assessment in the bioprocess industry**: Methods for reducing risk (physical and biological containment, safe performance of techniques), levels of containment in biotechnology; Risks associated with large scale industrial processes- escape of microorganisms- risks to personnel and the environment; Risks associated with fermentations under higher levels of containment (LS1, LS2 and LS3 levels); Risks by accidents (breakage and leakage) at various containment levels; Assessment of risks associated with biomass and open fermentations.	4
5	**Ensuring safety in bioprocessing**	
5.1	**Engineering for safe bio-processing:** Good industrial large scale practice (GILSP), containment features; Design for safety- facility design, bioreactors and process engineering.	3
5.2	**Containment in the manufacture of rDNA-derived products**: Safety precautions and containment categories, general principles of primary and secondary containment.	3
5.3	**Monitoring and validation in biotechnological processes**: Importance of detection of air and surface contamination- methods for detection and enumeration of air and surface contaminants. Monitoring of large scale	4

	and pilot-plant operations, controlling improvements in containment, validation of air filters	

SEMESTER V

HONOURS

BTT393	IMMUNOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		VAC	4	0	0	4

Preamble: The student will be equipped in understanding the various techniques used in immunology

Prerequisite: Basic knowledge in Biochemistry and Molecular Biology

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basic concept of immune system, auto immune diseases and immune diagnostic kits.
CO 2	Analyse antigen-antibody interaction and design recombinant antibody for immune-therapy
CO 3	Understand the use of vaccine to manipulate immune response
CO 4	Understand various techniques used in immune therapy.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1				3			2					2
CO 2				3			2					3
CO 3				3			2					2
CO 4				3	2		3					2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the basic concept of immune system, auto immune diseases and immune diagnostic kits

1. Describe the cells of immune system.
2. Give the details about the autoimmune disorders
3. Explain about immunodeficiency disorders.

Course Outcome 2 (CO2): Analyse antigen-antibody interaction and design recombinant antibody for immune-therapy

1. Justify the role of MHC.
2. Give the details about the protoplast technology.
3. Recall the process of activation of T-cells.

Course Outcome 3(CO3): Understand the use of vaccine to manipulate immune response

1. Explain the process of mAbproduction.
2. Explain the process recombinant vaccines.
3. Describe the process of immunization.

Course Outcome 4 (CO4): Understand various techniques used in immune therapy

1. Demonstrate the general steps in transplantation
2. Give the details about AIDS.
3. Describe the process of inflammation.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B. TECH DEGREE(HONORS) EXAMINATION ________ ____ 20__

Course Code: BTT393

Course Name: IMMUNOTECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	What are the different cells of immune system?
	b)	Explain the significance humoral immunity
	c)	Explain the process of allograft rejection.
	d)	What is the significance of B cell?
	e)	List out the applications of monoclonal antibodies.
	f)	Describe the types of autoimmune disorders.
	g)	Give a note on hypersensitivity
	h)	Elaborate the significance of chemiluminescence assay.
	i)	Give a note on immunofluorescence.
	j)	Brief about Western blot analysis

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Explain the chemical, physical and metabolic functions of different constituents	(14)
		OR	
3	a)	Justify the role of carbon dioxide in animal cell culture	(7)
	b)	Describe the role of adjuvants and haptens.	(7)
4	a)	Elaborate about MHC.	(14)
		OR	
5	a)	Demonstrate the process of monoclonal antibody production?	(7)

	b)	Explain about antigen processing and presentation process	(7)
6		Explain the immunologic basis of graft rejection.	(14)
		OR	
7	a)	Elaborate the significance of transplantation antigens.	(8)
	b)	Justify the implementation of immunization schedule.	(6)
8		Explain Complement system and its pathways.	(14)
		OR	
9	a)	How does immune response to infections occur?	(7)
	b)	Explain the mechanism of inflammation.	(7)
10		Describe in detail about fluorescence activated cell sorting analysis.	(14)
11		Elaborate the principle and applications of ELISA.	(14)
****			

Syllabus

Module 1

Introduction to Immune system: Cells of immune system; innate and acquired immunity; primary and secondary lymphoid organs; Antigens: Chemical and biological factors affecting antigenicity/Immunogenicity and molecular nature, Haptens, adjuvants, Antibodies: their structure and function, theory of clonal selection. Process of haematopoiesis and role of each cells, Humoral and Cell mediated immunity.

Module 2

B cells and T cells: B-lymphocytes and their activation, antibody genes and generation of diversity, production of monoclonal antibodies and applications, Thymus derived lymphocytes (T cells) - their ontogeny and types, Activation of T-cells, Major histocompatibility Complex (MHC) Complex - MHC Class I and II molecules. Antigen processing and presentation process.

Module 3

Complement system and its pathways: Complement system and its pathways. Gell and Coombs classification of Hypersensitivity reactions and Diagnosis and treatment. Autoimmune disorders, types and its treatment. Immune response to infections: immunity to viruses, bacteria, fungi and parasites, Immunodeficiency disorders: Primary and secondary AIDS. Injury and inflammation.

Module 4

Transplantation and vaccines : Transplantation and its classification, Immunologic basis of graft rejection and its mechanism, transplantation antigens, tissue typing role of MHC molecules in allograft rejection, Clinical transplantations, bone marrow, HSC transplantation and immune suppressive therapy. Vaccines and their types, immunization schedule.

Module 5

Immunological Techniques : Antigen antibody interaction – Precipitation reactions, Agglutination reactions, Blood typing, A, B, ABO & Rh factor, principles and applications of ELISA, Radio Immuno Assay (RIA), Western blot analysis, immuno-electrophoresis, Immunofluorescence, chemiluminescence assay, fluorescence activated cell sorting analysis. Immunoblotting and immunohistochemistry

Text Books

1. Janis Kuby, Immunology,W.H Freeman & Company.
2. Roitt I.M., Brostoff J and Male D.K Immunology Mosby Publication
3. Ivan I., Immunological Methods manual, academic Press.
4. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988.

Reference Books

1. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 1998.
2. Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold spring harbor laboratory.
3. Charles Janeway, Immunobiology: The Immune System in Health and Disease, Garland Science, 2005.
4. Richard Coico, Geoffrey Sunshine, Immunology: A Short Course, John Wiley & Sons, 2007.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Immune system**	
1.1	Cells of immune system; innate and acquired immunity	2
1.2	Primary and secondary lymphoid organs	1
1.3	Antigens: Chemical and biological factors affecting antigenicity	2

	/immunogenicity and molecular nature	
1.4	Haptens, adjuvants, Antibodies: their structure and function, theory of clonal selection	2
1.5	Process of haematopoiesis and role of each cells, Humoral and Cell mediated immunity	2
2	**B cells and T cells**	
2.1	B-lymphocytes and their activation, antibody genes and generation of diversity	2
2.2	Production of monoclonal antibodies and applications, Thymus derived lymphocytes (T cells) - their ontogeny and types	3
2.3	Activation of T-cells	1
2.4	Major histocompatibility Complex (MHC) Complex - MHC Class I and II molecules	2
2.5	Antigen processing and presentation process	2
3	**Complement system and its pathways**	
3.1	Complement system and its pathways.	2
3.2	Gell and Coombs classification of Hypersensitivity reactions and Diagnosis and treatment	2
3.3	Autoimmune disorders, types and its treatment	2
3.4	Immune response to infections: immunity to viruses, bacteria, fungi and parasites	2
3.5	Immunodeficiency disorders: Primary and secondary AIDS. Injury and inflammation	
4	**Transplantation and Vaccines**	
4.1	Transplantation and its classification, Immunologic basis of graft rejection and its mechanism	2
4.2	Transplantation antigens, tissue typing role of MHC molecules in allograft rejection	2
4.3	Clinical transplantations, bone marrow, HSC transplantation and immune suppressive therapy	2
4.4	Vaccines and their types	2
4.5	Immunization schedule	1
5	**Immunological Techniques**	

5.1	Antigen antibody interaction – Precipitation reactions, Agglutination reactions, Blood typing, A, B, ABO & Rh factor	2
5.2	Principles and applications of ELISA, Radio Immuno Assay (RIA)	2
5.3	Western blot analysis, immuno-electrophoresis, Immunofluorescence, chemiluminescence assay	3
5.4	Fluorescence activated cell sorting analysis	2
5.5	Immunoblotting and immunohistochemistry	1

BTT395	ENVIRONMENTAL POLLUTION MONITORING AND CONTROL	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: To impart knowledge about different types of pollution and its treatment

Prerequisite: Basic knowledge about environment and ecosystems

Course Outcomes: After the completion of the course the student will be able to

CO 1	Recognize the environmental legislation and regulation aimed at protecting the environment from harmful actions and work accordingly
CO 2	Comprehend and design different types of waste water treatment methods
CO 3	Predict suitable treatment and disposal methods for industrial and hazardous wastes
CO 4	Identify air and noise pollution sources and select control methods

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	2	-	-	3	3	3	-	-	-	3
CO2	-	-	2	-	-	3	3	-	-	-	-	-
CO3	-	-	2	-	-	3	3	-	-	-	-	-
CO4	-	-	2	-	-	3	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Recognize the environmental legislation and regulation aimed at protecting the environment from harmful actions and work accordingly

  1. List out any three Indian standard specifications and its range for drinkingwater quality.
  2. Describe the need of water quality standards.
  3. What is the need of environmental legislation in India?

- **Course Outcome 2 (CO2):** Comprehend and design different types of waste water treatment methods.

  1. Explain the ion exchange method of water softening with a sketch.
  2. Discuss and compare the trickling filter and activated sludge process for the treatment of wastewater.
  3. What do you understand by aerobic suspended and aerobic attached growthtreatment?

- **Course Outcome 3(CO3):**Predict suitable treatment and disposal methods for industrial and hazardous wastes

  1. Enumerate the treatment methods used for the waste management in diary Industry.
  2. Discuss hazardous-waste management.

3. Describe various human health risks involved in solid waste disposal bycomposting.

Course Outcome 4 (CO4): Identify air and noise pollution sources and select control methods

1. Explain the effects of air pollution in living and non living beings
2. What are the sources of air pollution?
3. Explain settling chambers, cyclone separators, fabric filtersand wet scrubbers

Model Question Paper

			Total Pages:
Reg No.:_______________			Name:_________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH SEMESTER B. TECH DEGREE(HONORS) EXAMINATION ________ ____ 20__
Course Code: BTT 395
Course Name: ENVIRONMENTAL POLLUTION MONITORING AND CONTROL

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1	(a)	Write about Environmental Protection Act
	(b)	Differentiate between BOD & COD
	(c)	What is floatation? Write the types
	(d)	Differentiate between coagulation and flocculation
	(e)	Write about AOPs
	(f)	What is a SBR?
	(g)	What is Incineration?
	(h)	Describe landfill reclamation in solid waste management.
	(i)	Write the concept of ‘Zero waste’
	(j)	What is the significance of waste recycling

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Write about sources and classification of waste water	(14)

		OR	
3	(a)	Write the physical, chemical and biological characteristics of waste water	(8)
	(b)	Briefly explain water collection and sampling methods	(6)
4		With a neat flow diagram explain the methods of waste water treatment.	(14)
		OR	
5		Briefly explain about various physical methods of waste water treatment	(14)
6	(a)	Why are aeration devices a vital part of biological reactors? Name and describethe two major aeration techniques, indicating the kinds of biological reactors in which they are most often used	(6)
	(b)	With a neat diagram, explain the working of MBBR	(8)
		OR	
7	(a)	Describe a rotating biological contactor reactor with a neat sketch.	(8)
	(b)	What do you understand by aerobic suspended and aerobic attached growth treatment? Explain with examples?	(6)
8	(a)	Describe various human health risks involved in solid waste disposal by Composting.	(6)
	(b)	Discuss hazardous-waste management.	(8)
		OR	
9		Enumerate the treatment methods used for the waste management in paper and pulp industry.	(14)
10		What are the global effects of air pollution and how it can be reduced?	(14)
		OR	
11		Describe in detail of settling chambers & cyclone separators	(14)
		****	

Syllabus

Module 1:

Introduction to environmental pollution monitoring and control.Environmental legislation and regulation.

Sources and classification of wastewater.Physical, chemical and biological characteristics of waste water.Types of water pollutants and their effects.Water quality standards.Wastewater sampling and analysis.Determination of organic matter.Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand.Waste water microbiology.

Module 2:

Significance of physico- chemical treatment of waste water - Selection criteria - Advantages and Disadvantages -Applications.

Principles of flow equalization, screening, grit removal and oil and grease removal.Sedimentation.Particle settling theory.Types of settling. Flotation – diffused air flotation and dissolved air flotation. Application in water and waste water treatment.Aeration and gas transfer processes. Rates of transfer.Air stripping.

Chemical Treatment – Role of Chemical Unit Processes in Wastewater Treatment.Coagulation – Coagulation processes, stability of colloids and destabilization, coagulants.

Flocculation theory, orthokinetic and perikinetic.

Module 3:

Fundamentals of biological treatment – Overview – aerobic and anaerobic treatment. Microbial growth kinetics – Factors affecting growth – attached and suspended growth.

Suspended growth Biological treatment systems –Activated Sludge process, Sequencing Batch reactors, Membrane Biological Reactors- -Suspended growth aerated lagoons.Attached growth Biological treatment systems- Trickling filters, Rotating Biological Contactor (RBC), Moving Bed Bio Reactor (MBBR), Fluidised Bed Bio Reactor (FBBR),Up flow Anaerobic Sludge Blanket (UASB).

Advanced waste water treatment – Introduction to depth filtration, principal mechanisms of filtration. Adsorption processes, causes and types of adsorption, Ion exchange – exchange materials, exchange capacity, ion exchange chemistry and reactions. Introduction to membrane processes. Advanced Oxidation Processes (AOPs).

Module 4:

Solid waste management- types and sources of solid wastes, present scenario in India, functional elements of solid waste management, solid waste sampling, composition and characterization, problems and issues in existing waste management practices.Volume reduction, Processing and materials recovery, selection of suitable processing techniques, biological – chemical – thermal processing, Sanitary landfill, Incineration, Composting-vermi, aerobic and anaerobic. Conventional gasification – plasma arc gasification

Treatment of industrial waste - pulp and paper mill - textile mill - distillery - dairy - petroleum refinery - fertilizer industry. Hazardous waste -types of hazardous waste - health effects - treatment methods.

Module 5:

Air Pollution- Sources and Classification, Global effects of air pollution –global warming and ozone depletion. Standards-ambient air quality standards-emission standards. Air sampling methods-Air quality index-Measurement-ambient and source sampling.

Air Pollution Control – Control methods and equipments-Gravitational settling chambers, Cyclone separators, Fabric filtration, Electrostatic precipitators, Dry and wet Scrubbing.

Indoor air quality management: Measurement, control and preventive measures of indoor air quality and management. Control Measures for Industrial Applications.

Noise pollution - effects and noise control methods.

Recycling and reuse of wastes, waste minimization, Zero waste strategies.

Text Books

1. Rao C.S., Environmental Pollution Control Engineering, New age International Pub.
2. Peavy H.S., Rose D.R.&Tchobanoglous G., Environmental Engineering, McGraw Hill
3. Metcalf and Eddy, *Wastewater engineering, Treatment and Reuse*, Tata McGraw-Hill, New Delhi, 2003.

Reference Books

1. Susan J Masten, Principles of Environmental Engineering and Science, McGraw-Hill Higher Education, 2004.
2. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
3. W WNazaroff, Lisa Alvarez-Cohen, Environmental Engineering Science, Wiley, 2001.
4. Sawyer C N, McCarty P L, Parkin G F, Chemistry for Environmental Engineering, TataMcGraw-Hill, New Delhi, 2003.
5. Casey. T.J. *Unit Processes in Water and Wastewater Engineering*, John Wiley & Sons, England, 1993.
6. Sincero A.P. &Sincero G.A., Environmental Engineering-A Design Approach, Prentice Hall of India.
7. Mahajan S.P., Pollution Control in Process Industries, Tata McGraw Hill
8. Perkins H.C., Air Pollution, McGraw Hill

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1		
1.1	Introduction to environmental pollution monitoring and control. Environmental legislation and regulation	2
1.2	Sources and classification of wastewater. Physical, chemical and biological characteristics of waste water. Types of water pollutants and their effects. Water quality standards.	2

1.3	Wastewater sampling and analysis. Determination of organic matter. Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand. Waste water microbiology.	2
2		
2.1	Significance of physico- chemical treatment of waste water - Selection criteria - Advantages and Disadvantages –Applications.	1
2.2	Principles of flow equalization, screening, grit removal and oil and grease removal.Sedimentation. Particle settling theory. Types of settling.	3
2.3	Flotation – diffused air flotation and dissolved air flotation. Application in water and waste water treatment. Aeration and gas transfer processes. Rates of transfer. Air stripping.	2
2.4	Chemical Treatment – Role of Chemical Unit Processes in Wastewater Treatment.Coagulation – Coagulation processes, stability of colloids and destabilization, coagulants. Flocculation theory, orthokinetic and perikinetic.	2
3		
3.1	Fundamentals of biological treatment – Overview – aerobic and anaerobic treatment. Microbial growth kinetics – Factors affecting growth – attached and suspended growth.	2
3.2	Suspended growth Biological treatment systems –Activated Sludge process, Sequencing Batch reactors, Membrane Biological Reactors- -Suspended growth aerated lagoons.	3
3.3	Attached growth Biological treatment systems- Trickling filters, Rotating Biological Contactor (RBC), Moving Bed Bio Reactor (MBBR), Fluidised Bed Bio Reactor (FBBR),Up flow Anaerobic Sludge Blanket (UASB).	3
3.4	Advanced waste water treatment – Introduction to depth filtration, principal mechanisms of filtration. Adsorption processes, causes and types of adsorption, Ion exchange – exchange materials, exchange capacity, ion exchange chemistry and reactions. Introduction to membrane processes. Advanced Oxidation Processes (AOPs).	3
4		
4.1	Solid waste management- types and sources of solid wastes, present scenario in India, functional elements of solid waste management, solid waste sampling, composition and characterization, problems and issues in existing waste management practices	2
4.2	Volume reduction, Processing and materials recovery, selection of suitable processing techniques, biological – chemical – thermal processing, Sanitary landfill, Incineration, Composting-vermi,	2

	aerobic and anaerobic. Conventional gasification – plasma arc gasification	
4.3	Treatment of industrial waste - pulp and paper mill - textile mill - distillery - dairy - petroleum refinery - fertilizer industry. Hazardous waste -types of hazardous waste - health effects - treatment methods.	3
5		
5.1	Air Pollution- Sources and Classification, Global effects of air pollution –global warming and ozone depletion. Standards- ambient air quality standards-emission standards. Air sampling methods-Air quality index-Measurement-ambient and source sampling.	3
5.2	Air Pollution Control – Control methods and equipments- Gravitational settling chambers, Cyclone separators, Fabric filtration, Electrostatic precipitators, Dry and wet Scrubbing.	3
5.3	Indoor air quality management: Measurement, control and preventive measures of indoor air quality measures and management. Control Measures for Industrial Applications.	2
5.4	Noise pollution - effects and noise control methods. Recycling and reuse of wastes, waste minimization, Zero waste strategies.	2

BTT397	MODELING OF BIOREACTORS	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: To provide an overview of modeling and outline its applications in the engineering design and optimization of bioreactor systems

Prerequisite: BTT202, BTT206

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basic principles of modeling and its implications in the design and optimization of bioreactor systems and processes.
CO 2	Acquire a basic knowledge of the nature of key information required for developing a coherent model for a bioreactor system.
CO 3	Identify and apply pertinent tools for modeling of a bioreactor system, based on the information collected/provided.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	3	-	3	3	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Understand the basic principles of modeling and its implications in the design and optimization of bioreactor systems and processes.

  1. Discuss the classification of models with suitable examples for each type, in the context of bio reaction engineering.
  2. Illustrate the general modeling procedure for a bioreactor system.
  3. Outline the implications of mixing-bio reaction interactions on the design of stirred, aerated bioreactor systems.

- **Course Outcome 2 (CO2):**Acquire a basic knowledge of the nature of key information required for developing a coherent model for a bioreactor system.

  1. Outline the key physical and biological information required for developing the model for a batch bioreactor system.
  2. Identify the factors contributing to imperfect mixing in a stirred tank bioreactor system and explain their implications in modeling.
  3. Discuss in quantitative terms, the interrelations between cells and their physic-chemical environment in a bioreactor system.

- **Course Outcome 3(CO3):**Identify and apply pertinent tools for modeling of a bioreactor system, based on the information collected/provided.

  1. Explain the formulation of general material and energy balance equations for batch and continuous bioreactors.

2. Discuss the key elements of a population balance equation, with a suitable example.
3. Elaborate on the various approaches for quantitative characterization of mass transfer- bio reaction interactions in homogeneous and heterogeneous reaction systems.

Model Question Paper

			Total Pages: 02
Reg No.:______________		Name:________________________	
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH SEMESTER B. TECH DEGREE (HONORS) EXAMINATION ________ ____ 20__			
Course Code: BTT 397			
Course Name: MODELING OF BIOREACTORS			
Max. Marks: 100			Duration: 3 Hours
PART A			

		Answer all questions, each carries 3 marks.
1	(a)	Define a model. Discuss the advantages of modelling in the context of processsystemsdesign and optimization.
	(b)	Explain parameter sensitivity in process models, with a suitable example.
	(c)	Elaborate on mass and energy yield coefficients. Give the relevant mathematical expressions for each.
	(d)	Illustrate the simple material balance for a batch bioreactor system.
	(e)	Distinguish between macro mixing and micro mixing.
	(f)	Explain reaction characteristic time. Outline its relevance in the analysis of mixing-bio reaction interactions.
	(g)	Give an example for oxygen transfer model in a large scale bioreactor.
	(h)	Discuss the salient features of a finite difference model in a heterogeneous reaction system.
	(i)	Distinguish between structured and unstructured models, citing suitable examples.
	(j)	Explain the significance of physiological state vector in biological population balances.

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Outline the classification of process models with suitable examples.	(14)
		OR	

3		Illustrate the general modeling procedure for a bio reaction system.	(14)
4		Discuss the general material and energy balances applicable to a continuous stirred tank bioreactor.	(14)
		OR	
5		Elaborate on the steady and unsteady mass balances for a plug flow reactor. Specify all pertinent assumptions used.	(14)
6		Explain the different mixing mechanisms in stirred, aerated bioreactors. Append neat sketches.	(14)
		OR	
7		Elaborate on the key considerations in developing a model for a non-perfectly mixed bioreactor.	(14)
8		Explain the interrelationships between diffusion and biological reaction in an immobilized enzyme system. Discuss the key parameters used to quantitatively express the degree of such relationships.	(14)
		OR	
9		Illustrate the pathway for oxygen transfer from a gas bubble to an intracellular reaction site within an immobilized biocatalyst pellet. Depict each step using suitable mathematical models.	(14)
10		Elaborate on metabolic models, with a suitable example.	(14)
		OR	
11		Explain the utility of general population balance equations. Illustrate with an example.	(14)
****			

Syllabus

Module 1: Modeling basics

Definition of a model, advantages of modeling, classification of models- physical, mathematical and verbal models; variables and parameters in a model, process models- Lumped and distributed parameter models, complexity of the model, parameter sensitivity- Use of models for design and optimization of bioreactors-general modeling procedure. Physical and biological information for bioreactor modeling- Interrelations between cells and their physical/chemical environment.

Module 2: Tools for bioreactor modeling

Formulation of general and partial material balance equations- Types of mass balance equations, balancing procedure, total mass balances, component balances for reacting systems- Simple stoichiometry, elemental balancing, mass and energy yield coefficients- Energy balancing for bioreactors. General balances for tank-type biological reactors**-** Batch, continuous and fed-batch**;** Modeling of tubular plug-flow reactors- steady and unsteady state balancing.

Module 3: Analysis of mixing-bio reaction interactions

Characterization of mixing- concentration distribution, concentration field, macro mixing and micro mixing, rate of mixing, mixing mechanisms, characteristic mixing times, contribution of aeration to macro mixing. Reaction characteristic time, competition between mixing and biological reaction, analysis and modeling of couplings between mixing and bio reaction- modeling of non-perfectly mixed bioreactors.

Module 4: Mass transfer in biological reactors

Interphase gas-liquid mass transfer, general oxygen balances for gas-liquid transfer and its applications, models for oxygen transfer in large-scale bioreactors. Diffusion and biological reaction in immobilized biocatalyst systems: External mass transfer, internal diffusion and reaction- finite difference model, dimensionless parameters, effectiveness factor concept.

Module 5: Equilibrium/dynamic responses

Dynamic response in terms of growth rate, assimilation and metabolism, equilibrium /dynamic models- unstructured and structured kinetic models, metabolic models.

Biological population balance: Physiological state vector, number density function, population average value, formulation of general population balance equation.

Text Books

1. Jerome Morchain *Bioreactor Modeling- Interactions between hydrodynamics and biology* (2017) ISTE Press, Elsevier.
2. Najim K., "Process Modeling and Control in Chemical Engineering", CRC, 1990.

Reference Books

1. I.J. Dunn, E.Heinzle, J.Ingham, J.E. Prenosil *Biological Reaction Engineering- Dynamic modeling fundamentals with simulation examples*, Second edition (2003), Wiley- VCH.
2. A.Fiechter (ed.) *Bioprocess Parameter Control* in *Advances in Biochemical Engineering/Biotechnology* Vol.30 (1984), Springer- Verlag.
3. Denn M. M., "Process Modeling", Longman, 1986.
4. Luyben W. L., "Process Modeling Simulation and Control for Chemical Engineers", 2nd Ed., McGraw Hill, 1990.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Modeling basics**	
1.1	Definition of a model, advantages of modeling, classification of	3

	models- physical, mathematical and verbal models; variables and parameters in a model.	
1.2	Process models- Lumped and distributed parameter models, complexity of the model, parameter sensitivity	3
1.3	Use of models for design and optimization of bioreactors-general modeling procedure. Physical and biological information for bioreactor modeling- Interrelations between cells and their physical/chemical environment.	4
2	**Tools for bioreactor modeling**	
2.1	Formulation of general and partial material balance equations- Types of mass balance equations, balancing procedure, total mass balances, component balances for reacting systems- Simple stoichiometry, elemental balancing, mass and energy yield coefficients.	3
2.2	Energy balancing for bioreactors. General balances for tank-type biological reactors- Batch, continuous and fed-batch	3
2.3	Modeling of tubular plug-flow reactors- steady and unsteady state balancing.	3
3	**Analysis of mixing-bio reaction interactions**	
3.1	Characterization of mixing- concentration distribution, concentration field, macro mixing and micro mixing, rate of mixing, mixing mechanisms, characteristic mixing times, contribution of aeration to macro mixing	4
3.2	Reaction characteristic time, competition between mixing and biological reaction, analysis and modeling of couplings between mixing and bio reaction- modeling of non-perfectly mixed bioreactors.	4
4	**Mass transfer in biological reactors**	
4.1	Interphase gas-liquid mass transfer, general oxygen balances for gas-liquid transfer and its applications, models for oxygen transfer in large-scale bioreactors	4
4.2	Diffusion and biological reaction in immobilized biocatalyst systems	3
4.3	External mass transfer, internal diffusion and reaction- finite difference model, dimensionless parameters, effectiveness factor concept	4
5	**Equilibrium/dynamic responses**	
5.1	Dynamic response in terms of growth rate, assimilation and metabolism, equilibrium /dynamic models- unstructured and structured kinetic models, metabolic models.	4
5.2	**Biological population balance**: Physiological state vector, number density function, population average value, formulation of general population balance equation.	3

SEMESTER VI

BTT302	BIOINFORMATICS	CATEGORY	L	T	P	CREDIT
		PCC	2	0	2	4

Preamble: Introduction to computers and Bioinformatics, Basic concepts of biomolecules, Types of Nucleotide Sequence and DNA sequencing methods, Bioinformatics Resources, Sequence databases, Sequence file formats, Sequence Analysis, Sequence alignment.

Prerequisite: Basic knowledge in molecular biology, internet basics

Course Outcomes: After the completion of the course the student will be able to

CO 1	Differentiate various biological databases.
CO 2	Infer the terminologies and concepts in the field.
CO 3	Generate and interpret the sequence alignment and implement the scoring matrices.
CO 4	Articulate the different bioinformatics tools.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-		3	-	-	-	-	-	-	-
CO 2	-	-	2	2	2	-	-	-	-	-	2	2
CO 3	-	-	2	2	2	-	-	-	-	-	2	-
CO 4	-	-	2	2	3	2	-	-	-	-	2	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Differentiate various biological databases

1. How can you fetch the protein sequence data?
2. How can you retrieve the nucleotide sequence of haemoglobin?
3. How can you retrieve the 3D structure of a specific protein?

Course Outcome 2 (CO2): Infer the terminologies and concepts in the field

1. Define sequence alignment.
2. What do you infer when two protein sequences have 60% identity?
3. Differentiate between orthologs and paralogs.

Course Outcome 3(CO3): Generate and interpret the sequence alignment and implement the scoring matrices

1. Differentiate Local and Global alignment.
2. Align two nucleotide sequences using Needleman Wunsch algorithm (match score=+5, mismatch=-2, gap=-2)
3. Align two nucleotide sequences using Smith Waterman algorithm (match score=+5, mismatch=-2, gap=-2)

Course Outcome 4 (CO4): Articulate the different bioinformatics tools

1. What is Pymol software used for?
2. Give example for multiple sequence alignment tools.
3. Explain the steps involved in homology modelling.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT302

Course Name: BIOINFORMATICS

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1	a)	What is FASTA format? Give example.
	b)	Name any Chemical database. How it can be used?
	c)	Differentiate opening gap penalty and extension gap penalty.
	d)	What is blast used for?
	e)	Differentiate local and global sequence alignment
	f)	Differentiate PAM and BLOSUM matrices.
	g)	What is Genscan used for?
	h)	Name any 5 structure prediction software.
	i)	What is meant by docking?
	j)	Explain about any two tools used in CADD.

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Point out the different bioinformatics tools and repositories that can be used to explore more about the biological data.	(14)
		OR	
3		How are biological databases classified? Explain in detail about each database.	(14)
4		Explain about the working of BLAST algorithm? Which are the different variants of BLAST?	(14)
		OR	
5		Briefly explain about the applications of Multiple Sequence Alignment. Illustrate with an example explain about the construction of a phylogenetic tree using distance based method.	(14)
6		Align two nucleotide sequences using Needleman Wunsch algorithm (match score=+5, mismatch=-2, gap=-2)	(14)
		OR	

7		Align two nucleotide sequences using Smith Waterman algorithm (match score=+5, mismatch=-2, gap=-2)	(14)
8		Explain the steps involved in homology modelling. Give example of homology modelling tools.	(14)
		OR	
9		Differentiate between the *ab initio* based and homology based gene prediction methods.	(14)
10		Summarise the steps involved in CADD. Give example of software used in the field.	(14)
		OR	
11		List out the names of any 2 visualization tools. Explain in detail about each.	(14)
****			

Syllabus

Module 1:

Introduction: Emergence of Bioinformatics, Applications in the field-Biological Databases-Formats- Nucleic acid and Protein sequence Databases, Structure Databases, Chemical Databases, Literature Databases

Module 2:

Biological Databases: Measurement of sequence similarity; Similarity and homology. Pairwise sequence alignment: Basic concepts of sequence alignment, gap penalties, Similarity search- BLAST, FASTA. Multiple Sequence Alignment, Phylogeny

Module 3:

Needleman and Wunsch, Smith and Waterman algorithms for pair-wise alignments,Use of pair-wise alignments for analysis of Nucleic acid and protein sequences and interpretation of results. PAM and BLOSUM

Module 4:

Gene prediction, Protein prediction, Structure prediction, Protein modeling, Internet resources and basic principle underlying the *in silico* predictions.

Module 5:

3D structure visualization tools, Docking, Steps in Computational Aided Drug Discovery (CADD), Tools and databases in CADD

Text Books

1. Teresa K Attwood, David J Parry-Smith, Introduction to bioinformatics, Pearson Education. 1999

2. Baxevanis A D, Francis Ouellellette B F, Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins, Wiley Interscience,2009.

Reference Books

1. Jean-Michel Claverie, Cedric Notredame, Bioinformatics *for Dummies*, Wiley Publishing Inc., 2007.

2. D W Mount, *Bioinformatics: Sequence and Genome Analysis*, 2/e, Cold Spring Harbor Laboratory, Press, New York. 2004.

3. Jin Xiong, *Essential Bioinformatics*, Texas A& M University,Cambridge University Press, 2006**.**

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Introduction	
1.1	Emergence of Bioinformatics, Applications in the field-	2
1.2	Nucleotide databases	1
1.3	Protein sequence databases	1
1.4	Structure databases	1
1.5	Chemical Databases	1
1.6	Literature Databases	
1.7	Sequence formats Flat file, FASTA	1
1.8	Lab session	
2.1	Sequence alignment, Terminologies; zones	1
2.2	Relevance of sequence comparison	1
2.3	BLAST Algorithm steps	1
2.4	Lab session	1
2.5	BLAST variants	1
2.6	FASTA working	1
2.7	Multiple sequence alignment applications	1
2.8	MSA methods	1
2.9	Phylogeny Terminologies	1
2.10	Methods of tree construction	2
3.1	Differentiate Local and Global Alignment	1
3.2	Smith Water man algorithm	2

3.3	Needleman Wunsch algorithm	2
3.4	PAM	2
3.5	BLOSUM	1
3.6	Lab session	2
4.1	Gene prediction principles	2
4.2	Gene prediction resources	1
4.3	Structure prediction principle	1
4.4	Structure prediction resources	1
4.5	Lab session	2
4.6	Protein modelling	1
5.1	Tools in visualization	1
5.2	Lab	2
5.3	Basic concepts in docking	1
5.4	Steps in docking	1
5.5	CADD	2
5.6	Types of drug discovery –structure based and ligand based; softwares; algorithms	2
5.7	Lab	2

BTT304	DOWNSTREAM PROCESSING	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: This course is important to understand the basic processes on-going in a Biological Fermentation from both upstream and downstream processing.

Prerequisite: Basics of biochemical engineering and unit operations

Course Outcomes: After the completion of the course the student will be able to

CO 1	Describe the principles that underlie major unit operations used in downstream processing of biotechnological and biopharmaceuticals
CO 2	Define and carry out separation and purification of fermentation products
CO 3	Integrate biological and engineering principles involved in the production and recovery of commercial products.
CO 4	Design and formulate effective strategies of downstream processing based on characteristics of biomolecules
CO5	Analyse the quality and characteristics of the purified product
CO6	Demonstrate the suitable downstream approaches comprising of new concepts and emerging technologies

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	3	2	-	2	-	-	-	-	-	-
CO 2	-	-	2	2	-	2	-	-	-	-	-	-
CO 3	-	-	3	2	-	2	-	-	-	-	2	-
CO 4	-	-	3	3	3	2	-	-	-	-	2	-
CO5	-	-	2	2	-	2	-	-	-	-	-	-
CO6	-	-	3	3	3	2	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20

Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Describe the principles that underlie major unit operations used in downstream processing of biotechnological and biopharmaceuticals

1. Discuss the mechanism of action of a detergent on the cell wall?
2. Show that enzymatic lysis is useful in sequential release of products
3. Discuss the process of Cavitation and its role in DSP

Course Outcome 2 (CO2): Define and carry out separation and purification of fermentation products

1. Differentiate between HVLV and LVHV products with examples
2. Illustrate the principle and application of foam fractionation
3. Outline the major steps involved in the product isolation and purification of any one intracellular enzyme

Course Outcome 3(CO3): Integrate biological and engineering principles involved in the production and recovery of commercial products.

1. Justify that "ultracentrifugation is useful in studying Subunit Stoichiometry of biomolecules?
2. Differentiate between dead and cross flow filtration with neat sketch??
3. Discuss the principle of separation of charged species by IEC

Course Outcome 4 (CO4): Design and formulate effective strategies of downstream processing based on characteristics of bio molecules

1. Explain working principle of Reverse micellar and supercritical fluid extraction?
2. What are aqueous biphasic systems, give steps involved in the aqueous two phase extraction of an enzyme
3. Differentiate between dead and cross flow filtration with neat sketch??

Course Outcome 5(CO5): Analyse the quality and characteristics of the purified product

1. Compare gel polarization and fouling. Discuss the factors which contribute to fouling of membranes.
2. Explain the principle of Isoelectric focussing. Append a neat sketch
3. Differentiate between Perstraction and Pervaporation

Course Outcome 6(CO6): Demonstrate the suitable downstream approaches comprising of new concepts and emerging technologies

1. Analyse the importance of in-situ bioproduct recovery and bioprocess integration in downstream processing
2. Explain Mier'ssuper saturation theory of crystallization.
3. With a neat sketch, describe the construction and operation of any one industrial crystallizer

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:_________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 304

Course Name: DOWNSTREAM PROCESSING

Max. Marks: 100 Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Discuss the electrical double layer concept
	b)	Discuss the kinetics of bead milling
	c)	Brief about the advantages and disadvantages of Ultra sonication
	d)	Elaborate the principle of Reverse micellar extraction theory
	e)	Differentiate between Orthokinetic and perikinetic aggregation
	f)	Explain the phenomenon of concentration polarization
	g)	How the enzymatic lysis is useful in sequential release of products
	h)	Explain the mechanism of gravity settling
	i)	Differentiate between HVLV and LVHV products with examples
	j)	Illustrate the principle and application of foam fractionation

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	List out the various cell disruption techniques and their mechanism	(10)
	b)	Explain the working principle of a high pressure homogenizer with the help of a neat sketch	(4)
		OR	
3	a)	Differentiate between dead and cross flow filtration with neat sketch??	(10)
	b)	Discuss the principle of separation of charged species by IEC	(4)
4	a)	Draw a neat sketch and explain the principle of the following: tubular bowl centrifuge ,disc stack centrifuges	(8)
	b)	A continuous disc stack centrifuge is operated at 5000 rpm for separation of bakers' yeast. At a feed rate of 60 L min−1, 50% of the cells are recovered. For operation at constant centrifuge speed, solids recovery is inversely proportional to the flow rate.	(6)

		(a)What flow rate is required to achieve 90% cell recovery if the centrifuge speed is maintained at 5000 rpm? (b) What operating speed is required to achieve 90% recovery at a feed rate of 60 L min−1?	
		OR	
5	a)	Differentiate between Perstraction and Pervaporation	(8)
	b)	Analyse the importance of in-situ bio product recovery and bioprocess integration in downstream processing	(6)
6		Outline the principle, operation, merits and limitations of supercritical fluid chromatography. Discuss its benefits over liquid chromatography.	(14)
		OR	
7	a	Explain the principle of Isoelectric focussing. Append a neat sketch	(7)
		Explain the principle of Bonded phase chromatography with neat sketch	(7)
8	a	List out various equipment used for conventional filtration and their working principles	(8)
	b	Describe Aq. Two phase extraction and reverse micellar extraction with applications	(6)
		OR	
9	a)	Explain Mier'ssuper saturation theory of crystallization.	(6)
	b)	With a neat sketch, describe the construction and operation of any one industrial crystallizer	(8)
10	a)	Explain the basic instrumentation and working of Liquid chromatography	(14)
		OR	
11	a)	List out different types of Commercial dryers with necessary explanation	(14)
		****	

Syllabus

Module 1:

Overview of bio separations: Broad classification of bio products, characteristics of fermentation broths, Introduction to high volume, low value products and low volume, high value products, need for downstream processing, criteria for choice of recovery processes, problems and requirements of bio product purification

Cell disruption: Analysis of various physical, chemical, enzymatic and mechanical methods for release of intracellular products- kinetics of bead milling and high pressure homogenization.

Module 2:

Flocculation: Importance in downstream processing, electrical double layer concept, DLVO theory, mechanisms of charge dependent flocculation ,Foam and bubble fractionation: Principle and operation-applications ,Centrifugal bio separations: Theory of centrifugal settling- basic equations, mechanism of sedimentation, Sedimentation coefficient, centrifuge selection-RCF, scale up of centrifuges- sigma analysis, equivalent time- Isopycnic sedimentation, ultra centrifugation,

Filtration: Equipment for conventional filtration- filter media, pre-treatment methods, general filtration theory- Darcy's law, compressible and incompressible filter cakes, filtration cycle, scale up and design of filtration systems, laboratory filtration tests- batch pre-treatment test, funnel filtration tests, filter leaf tests.

Module 3:

Extractive bio separations: General principles, analysis of batch and staged extraction - analytical and graphical methods, scale up and design of extractors- reciprocating plate extraction columns, centrifugal extractors- aqueous two phase extraction, reversed micellar extraction and supercritical fluid extraction theoretical principles, process, equipment and applications.

Precipitation: Factors influencing protein solubility, methods of precipitation, precipitate formation phenomena orthokinetic and perikinetic aggregation- Smoluchowski's equation- precipitate ageing- Camp number- design of precipitation systems.

Module 4:

Membrane separation processes: Cross flow filtration – filter media- ultra filtration and microfiltration membranes, filter modules, modes of operation, concentration polarization and fouling-reverse osmosis, dialysis, electro dialysis, Pervaporation, Perstraction.

Chromatographic separations: Classification of techniques, elution chromatography-retention theory, band broadening effects, separation efficiency, resolution, yield and purity. Bonded phase chromatography, Ion exchange chromatography, gel permeation chromatography, affinity chromatography- supercritical fluid chromatography – Chiral chromatography- expanded bed chromatography- simulated counter current chromatography- process scale up. Electro kinetic separations: Electrophoresis – Principles and techniques- Immunoelectrophoresis, capillary zone electrophoresis - Isoelectric focusing, isotachophoresis

Module 5:

Product crystallization: Basic principles- nucleation and crystal growth- Mier'ssuper saturation theory- kinetics of crystallization-analysis of dilution batch crystallization- commercial crystallizers- process crystallization of proteins scale up and design of crystallizers- Recrystallization. Product drying: Heat and mass transfer in drying- types of commercial dryers- vacuum dryers, freeze dryers, spray dryers- scale up and design of drying systems. Modern strategies: Bioprocess integration, intensification, in situ bioproduct recovery, combined operations- whole broth processing, mass recycle

Text Books

1. Sivasankar B, *Bio separations: Principles and Techniques*, Prentice-Hall of India Pvt. Ltd., 2008.

2. Paul A Belter, EL Cussler, Wei-shou Hu, *Bio separations: Downstream Processing for Biotechnology* - Wiley Interscience, 1988.

Reference Books

1. Harrison RG, Todd P, Rudge SR, Petrides DP, *Bio separations Science and Engineering*, Oxford Press, 2003.

2. Richard W Baker, *Membrane Technology and applications*, John Wiley & Sons Ltd., 2004.

3. McCabe, WL, Smith JC, Harriott P, *Unit Operation of Chemical Engineering*, 6/e, McGraw Hill, New York, 2000.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1:Overview of bio separations**	
1.1	Broad classification of bio products, characteristics of fermentation broths	1
1.2	Introduction to high volume, low value products and low volume, high value products, need for downstream processing	1
1.3	criteria for choice of recovery processes, problems and requirements of bio product purification	1
1.4	**Cell disruption**: Analysis of various physical, chemical, enzymatic and mechanical methods for release of intracellular products	3
1.5	Kinetics of bead milling and high pressure homogenization.	2
2	**Module 2:Flocculation**	
2.1	**Flocculation**: Importance in downstream processing, electrical	2

	double layer concept, DLVO theory, mechanisms of charge dependent flocculation	
2.2	**Foam and bubble fractionation**: Principle and operation-applications	1
2.3	**Centrifugal bio separations**: Theory of centrifugal settling- basic equations, mechanism of sedimentation, Sedimentation coefficient	2
2.4	Centrifuge selection-RCF, scale up of centrifuges- sigma analysis, equivalent time-	1
2.5	Isopycnic sedimentation, ultra centrifugation.	1
2.6	**Filtration**: Equipments for conventional filtration- filter media, pre-treatment methods, general filtration theory- Darcy's law,	1
2.7	Compressible and incompressible filter cakes, filtration cycle, scale up and design of filtration systems,	1
2.8	Laboratory filtration tests- batch pre-treatment test, funnel filtration tests, filter leaf tests.	1
3	**Module 3:Extractive bioseparations**	
3.1	General principles, analysis of batch and staged extraction -analytical and graphical methods,	1
3.2	Scale up and design of extractors- reciprocating plate extraction columns, centrifugal extractors	1
3.3	Aqueous two phase extraction, reversed micellar extraction and	1
3.4	Supercritical fluid extraction theoretical principles, process, equipment and applications.	1
3.5	**Precipitation**: Factors influencing protein solubility, methods of precipitation,	2
3.6	Precipitate formation phenomena orthokinetic and perikinetic aggregation	1
3.7	Smoluchowski's equation-precipitate ageing- Camp number-design of precipitation systems	1
4	**Module 4 :Membrane separation processes**:	
4.1	Crossflow filtration – filter media- ultra filtration and microfiltration membranes,	1
4.2	Filter modules, modes of operation,	1
4.3	Concentration polarization and fouling	1
4.4	-reverse osmosis, dialysis, electrodialysis, Pervaporation, Perstraction.	1
4.5	**Chromatographic separations:** Classification of techniques,	2

	elution chromatography- retention theory, band broadening effects, separation efficiency, resolution, yield and purity.	
4.6	Bonded phase chromatography, Ion exchange chromatography, gel permeation chromatography,	1
4.7	Affinity chromatography- supercritical fluid chromatography – Chiral chromatography-	1
4.8	Expanded bed chromatography- simulated counter current chromatography- process scale up.	1
4.9	**Electro kinetic separations**: Electrophoresis – Principles and techniques- Immuno electrophoresis	1
4.10	capillary zone electrophoresis - Isoelectric focusing, isotachophoresis	1
5	**Module 5 :Product crystallization**:	
5.1	Basic principles- nucleation and crystal growth-	1
5.2	Mier'ssupersaturation theory- kinetics of crystallization-analysis of dilution batch crystallization-	1
5.3	Commercial crystallizers- process crystallization of proteins scale up and design of crystallizers- Recrystallization.	1
5.4	**Product drying**: Heat and mass transfer in drying- types of commercial dryers- vacuum dryers, freeze dryers,	1
5.5	Spray dryers- scale up and design of drying systems.	1
5.6	**Modern strategies**: Bioprocess integration, intensification, in situ bioproduct recovery, combined operations- whole broth processing, mass recycle	3

BTT306	BIOREACTOR CONTROL AND INSTRUMENTATION	CATEGORY	L	T	P	CREDIT
		PCC	3	1	0	4

Preamble: To impart fundamentals of Bioreactor control

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Elucidate all relevant terms related to conventional process control
CO 2	Model simple systems and solve the mathematical equations using Laplace transforms
CO 3	Explain the various sensors in bioreactors
CO 4	Analyze the stability of open loop and closed loop systems and tune the controller

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	2	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	3	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

- **Course Outcome 1 (CO1):** Elucidate all relevant terms related to conventional process control

1. Write the difference between feedback and feed forward control
2. Define 'Transfer Function'
3. What is meant by 'Decay ratio'

- **Course Outcome 2 (CO2) :**Model simple systems and solve the mathematical equations using Laplace transforms

1. Write the transfer function for a second order system
2. Develop transfer function for a damped vibrator
3. Solve the following differential equation using Laplace Transform for the initial conditions given
$\frac{d2x}{dt2}$ + 4x=2e^{-1} ; (0) = 0 x'(0) = 0

- **Course Outcome 3(CO3):**Explain the various sensors in bioreactors

1. How pH is maintained in a Bioreactor?
2. How can we handle exothermic reactions in a Bioreactor?
3. Write about cascade control for Bioreactors

- **Course Outcome 4 (CO4):** Analyze the stability of open loop and closed loop systems and tune the controller

1. Explain CC controller tuning
2. What is Bode Stability criteria?
3. Write the importance of Characteristic equation

Model Question Paper

		Total Pages:
Reg No.:_______________		Name:______________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT306

Course Name: BIOREACTOR CONTROL AND INSTRUMENTATION

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	(a)	List out any 3 forcing functions and obtain its Laplace transforms
	(b)	State and prove Final value theorem
	(c)	What is meant by a second order system? Give 2 examples
	(d)	Compare the characteristics of an under damped and over damped systems
	(e)	Write the components of a Bioreactor
	(f)	With suitable examples, explain the difference between Servo and Regulatory problems
	(g)	Develop transfer function for P and PID Controllers
	(h)	Define Gain Margin (GM) and Phase Margin (PM)
	(i)	State and explain the Bode stability criteria
	(j)	What are the rules for plotting Root Locus

PART B

Answer any one full question from each module. Each carries 14 marks.

2	(a)	State and prove Initial value theorem	(4)
	(b)	Solve the following differential equation using Laplace Transform for the initial conditions given $\frac{d2x}{dt2}$ + 4x=2e^{-1} ; $x(0)$ = 0 $x'(0)$ = 0	(10)

		OR	
3	(a)	Illustrate the hardware elements of a tank heater system with the help of a neatdiagram?	(8)
	(b)	Explain the importance of State equations and degrees of freedom	(6)
4		A step change of magnitude 4 is introduced into a system having transferfunction $\frac{Y(s)}{X(s)} = \frac{10}{2S2+0.3s+0.5}$ Determine i. Percentage overshoot ii. Maximum value of Y(t) iii. Ultimate value of Y(t) iv. Period of oscillation v. Decay ratio	(14)
		OR	
5		A general second order process with transfer function G(s) = $\frac{Kp}{\tau 2+2\zeta\tau s+1}$ is controlled using a proportional controller of gain Kc. i) Obtain the equation for output for this process in a feedback loop if the dynamics of final control element and measuring device is assumed as unity. (4) ii) For a unit step change in set point derive the output for servo problem (3) iii) Illustrate the effect of the controller on the process parameters (5) iv) What is the ultimate response? (2)	(14)
6		With a neat diagram, explain various components Bioreactor control system	(14)
		OR	
7	(a)	Classify different types of feedback controllers. Enunciate each of them with its applications, advantages and disadvantage	(10)
	(b)	What are the characteristics of the ultimate response of a linear system with a transfer function G(s) to a sustained sinusoidal input?	(4)
8	(a)	Derive the frequency response characteristics of P and PI controllers (8)	(8)
	(b)	Illustrate the effect of PID controller in the feedback response of a first order process with transfer function G(s) = $\frac{Kp}{\tau ps+1}$	(6)
		OR	
9	(a)	Discuss a model based approach for control system design	(4
	(b)	Illustrate the bode plots for P,PI and PID controllers.	(10)

10		What are the steps involved in plotting Root locus diagram? Draw the root locus for the system having open loop transfer function $\frac{Kc}{(S+1)(S+2)(S+3)}$	(14)
		OR	
11	(a)	State Nyquist stability criterion and comment on Nyquist plots using an example.	(10)
	(b)	Explain on the following advanced control system i) Adaptive controllers	(4)
		****	

Syllabus

Module 1:

Introduction to process control with the help of examples of a tank heater system. Process control strategies- feedback, feed forward and inferential. Overview of control system design - model based approach - theoretical, empirical and semi empirical models.
General modeling principles. Classification of variables in process control. Importance of state variables, state equations and degrees of freedom.
Tools for solving models: Laplace Transforms: Definition of the Laplace transforms. Laplace transforms of some basic forcing functions - step, exponential, ramp, sinusoidal, cosine, pulse, impulse and translated functions, Laplace transform of derivatives and integrals, initial value theorem and final value theorem. Numerical problems

Module 2:

Transfer functions and their general characteristics. Transfer functions of a general first order and second order systems. Dynamics of a first order system for step and impulse input. First order systems and its general characteristics. Development of transfer function models for first order systems: a continuous single tank (mass storage) system and a mercury in glass thermometer system. Development of transfer function models for second order systems: multicapacity systems - two tanks connected in series, inherently second order systems - damped vibrator, first order system in the presence of a controller. Dynamics of second order systems - General characteristics of under damped, over damped and critically damped systems. Numerical problem on overshoot, decay ratio, period of oscillation, ultimate value and maximum value. Numerical problems on transfer functions and dynamic response of first and second order systems

Module 3:

Hardware elements of a control system. Explanation with the help of an example temperature control set up for a bioreactor.

Components of bioreactor, Inline, Online and Offline measurements of a bioreactor. Sensors for bioreactors – temperature, pressure, flow, DO concentration, pH, cell concentration, foam sensing, weight, agitation rate, biosensors in bioprocess monitoring, biosensors based on thermal effects and potentiometric biosensors. Transfer functions of measuring devices, transmission lines and final control elements (pneumatic control valves and control valve characteristics). Dead time processes. Types of feedback controllers. Control laws and transfer functions of P, PI and PID controllers.

Dynamic behaviour of feedback controlled processes. Difference between open loop and closed loop control system. Closed loop transfer function for feedback (positive and negative) processes. Servo and regulatory responses due to the presence of proportional control, integral control, derivative control action and composite control on the response of a feedback controlled process.

Module 4:

Frequency response characteristics of a general linear system, dead time process, pure capacitive process and their graphical representations. Frequency response characteristics of feedback controllers-P,PI and PID and composite controllers and their graphical representations. Frequency response characteristics of second order systems and graphical representation. Nyquist plots of first order, dead time and pure capacitive processes. Cross over frequency, Gain and Phase margin.

Module 5:

Stability analysis of feedback systems: Notion of stability, Stable and unstable systems, BIBO stability, Prediction of stability of transfer function for open loop and closed loop systems based on transfer function analysis. The characteristic equation, Routh Hurwitz criterion for stability. Numerical examples, Root locus analysis. Rules for plotting Root locus Development of Root locus for multi capacity systems. Numerical Examples, Bode stability criterion, Nyquist stability criterion

Design of feedback controllers: Outline of the design problems, simple performance criteria, time-integral performance criteria, selection of the type of feedback controller. Controller tuning- semi empirical tuning techniques -CC and ZN

Advanced Controls in Bioreactors – Introduction to dead time compensation, pH measurement and control, Oxygen measurement and control, Adaptive control and online estimation, Cascade control for jacketed bioreactors

Text Books

1. Stephanopoulose G, *Chemical Process Control: An Introduction to Theory and Practice*, Prentice Hall of India, New Delhi, 1993.

2. Coughanowr R D, LeBlanc E S, *Process Systems Analysis and Control,* McGraw Hill International Edition.

Reference Books

1. Luyben W L, *Process Modeling Simulation and Control for Chemical Engineers*, 2/e, McGraw Hill, Singapore, 1990.
2. Seborg D E, Edgar TF, Mellichamp D A, Doyle FJ, *Process Dynamics and Control,* 3/e, John Wiley & Sons, 2010.
3. Peter Harriot, *Process Control*, Tata McGraw Hill, 1972.S
4. Tapobrata Panda, *Bioreactor Analysis and Design*, Tata McGraw Hill, 2011.
5. E M T El Mansi, C F A Bryce, B Dahhou S Sanchez, A L Demain, A R Allmen, *Fermentation microbiology and biotechnology*, CRC Press, 2012.
6. P F Stanbury, A Whitaker and S J Hall, *Principles of Fermentation Technology,* Elsevier, 1995.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to process control**	
1.1	With the help of examples of a tank heater system. Process control strategies- feedback, feed forward and inferential.	2
1.2	Overview of control system design - model based approach - theoretical, empirical and semi empirical models.	2
1.3	**General modeling principles**. Classification of variables in process control. Importance of state variables, state equations and degrees of freedom.	2
1.4	**Tools for solving models**: Laplace Transforms: Definition of the Laplace transform. Laplace transforms of some basic forcing functions - step, exponential, ramp, sinusoidal, cosine, pulse, impulse and translated functions, Laplace transform of derivatives and integrals, initial value theorem and final value theorem. Numerical problems	4
2	**Transfer functions and their general characteristics**.	
2.1	Transfer functions of a general first order and second order systems. Dynamics of a first order system for step and impulse input.	2
2.2	First order systems and its general characteristics. Development of transfer function models for first order systems: a continuous single tank (mass storage) system and a mercury in glass	2

	thermometer system.	
2.3	Development of transfer function models for second order systems: multicapacity systems - two tanks connected in series, inherently second order systems - damped vibrator, first order system in the presence of a controller.	3
2.4	Dynamics of second order systems - General characteristics of under damped, over damped and critically damped systems. Numerical problem on overshoot, decay ratio, period of oscillation, ultimate value and maximum value. Numerical problems on transfer functions and dynamic response of first and second order systems	3
3		
3.1	**Hardware elements of a control system**. Explanation with the help of an example temperature control set up for a bioreactor.	1
3.2	**Components of bioreactor**, Inline, Online and Offline measurements of a bioreactor. Sensors for bioreactors – temperature, pressure, flow, DO concentration, pH, cell concentration, foam sensing, weight, agitation rate, biosensors in bioprocess monitoring, biosensors based on thermal effects and potentiometric biosensors.	2
3.3	Transfer functions of measuring devices, transmission lines and final control elements (pneumatic control valves and control valve characteristics). Dead time processes. Types of feedback controllers. Control laws and transfer functions of P, PI and PID controllers.	2
3.4	**Dynamic behaviour of feedback controlled processes**. Difference between open loop and closed loop control system. Closed loop transfer function for feedback (positive and negative) processes. Servo and regulatory responses due to the presence of proportional control, integral control, derivative control action and composite control on the response of a feedback controlled process.	3
4		
4.1	**Frequency response characteristics** of a general linear system, dead time process, pure capacitive process and their graphical representations. Frequency response characteristics of feedback controllers-P, PI and PID and composite controllers and their graphical representations.	3
4.2	Frequency response characteristics of second order systems and graphical representation.	2
4.3	Nyquist plots of first order, dead time and pure capacitive	3

	processes. Cross over frequency, Gain and Phase margin.	
5		
5.1	**Stability analysis of feedback systems**: Notion of stability, Stable and unstable systems, BIBO stability, Prediction of stability of transfer function for open loop and closed loop systems based on transfer function analysis.	2
5.2	The characteristic equation, Routh Hurwitz criterion for stability. Numerical examples, Root locus analysis. Rules for plotting Root locus Development of Root locus for multi capacity systems. Numerical Examples, Bode stability criterion, Nyquist stability criterion	3
5.3	**Design of feedback controllers**: Outline of the design problems, simple performance criteria, time-integral performance criteria, selection of the type of feedback controller. Controller tuning-semi empirical tuning techniques -CC and ZN	2
5.4	**Advanced Controls in Bioreactors** – Introduction to dead time compensation, pH measurement and control, Oxygen measurement and control, Adaptive control and online estimation, Cascade control for jacketed bioreactors	3

BTT308	COMPREHENSIVE COURSE WORK	Category	L	T	P	Credit	Year of Introduction
		PCC	1	0	0	1	2019

Preamble: The course is designed to ensure that the student has a firm understanding of the core principles and basic concepts in Biotechnology Engineering. It provides an opportunity for evaluating the students comprehension in the basic tenets and for them to demonstrate their grasp of the basic core Biotechnology Engineering subjects.

Pre-requisite: Nil

Course outcomes: After completion of this course, the student will able to:

CO1	Confidently prepare for competitive examinations in Biotechnology Engineering like GATE.
CO2	Comprehend the core principles and technologies in Biotechnology Engineering and answer multiple choice questions based on them with confidence
CO3	Communicate effectively with scientists and faculties in an academic environment.
CO4	Relate and analyze the comprehensive knowledge gained by him/her in the core courses to the field of Biotechnology Engineering

BTT 308 Comprehensive Course Work		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
	CO1	2	1				2								1	
	CO2	3	2		1		2				2		1	2		
	CO3	2	1				2				3				1	
	CO4	3	3		1	1	2						2			

Assessment pattern

Bloom's Category	End Semester Examination (Marks)
Remember	25
Understand	15
Apply	5
Analyze	5
Evaluate	
Create	

End Semester Examination Pattern:

A written examination will be conducted by the University at the end of the sixth semester.The written examination will be of objective type similar to the GATE examination.Syllabus for the comprehensive examination is based on following five Civil Engineering core courses.

BTT 203- Microbiology

BTT 205- Fluid Flow and Particle Technology

BTT 204- Principles of Biochemistry

CET 206-Bioprocess Engineering

CET 305–Molecular Biology

The written test will be of 50 marks with 50 multiple choice questions (10 questions from each module) with 4 choices of 1 mark each covering all the five core courses. There will be no negative marking. The pass minimum for this course is 25. The course should be mapped with a faculty and classes shall be arranged for practising questions based on the core courses listed above.

Written examination	:	50marks
Total	**:**	**50 marks**

Course Level Assessment and Sample Questions:

1) Which part of the compound microscope helps in gathering and focusing light rays on the specimen to be viewed?
    a. Eye piece
    b. Objective lens
    c. Condenser
    d. Magnifying lens

2) Which of the following is used in electron microscope?
    a. Electron beams
    b. magnetic fields
    c. light waves
    d. electronic beams and magnetic fields

3) Which of the following is used as a solidifying agent for media?
   a. Beef extract
   b. Peptone
   c. Agar
   d. Yeast extract

4) Which of the following microorganism are used in the production of antibiotics
   a. Penicillium
   b. *E.coli*
   c. Lactococcus
   d. Saccharomyces

5) Stoke's equation is valid in the Reynolds number range
   number a. 0.01 to 0.1
   b. 0.1 to 2
   c. 2 to 10
   d. 10 to 100

6) Water is flowing under laminar conditions in a pipe of length L . If the diameter of the pipe is doubled for a constant volumetric flow rate, the pressure drop across the pipe.
   a. decreases 2 times
   b. increases 16 times
   c. increases 2 times
   d. decreases 16 times

7) Where does TCA cycle take place
   a. Nucleus
   b. Cell wall
   c. Mitochondria
   d. Lysosome

8) The chromatographic separation based on charge is
   a. Ion exchange chromatography
   b. PAGE
   c. Immunosorption chromatography
   d. Size exclusion chromatography

9) Ribosomes are attached to_______________in the cytoplasm
   a. Golgibodies
   b. Endoplasmic reticulum
   c. Nucleus
   d. Lysosome

10) .Decimal reduction time of bacterial spores is 23 min at 121 ^{o}C and the death kinetics followed by the spores is first order. One litre medium containing 105 spores per mL was sterilized for 10 min at 121 ^{o}C in a batch sterilizer. The total number of spores in the medium after sterilization (assuming destruction of spores in heating and cooling period is negligible) will be

a. 4×10^{2}

b. 3.6×10^{7}

c. 4.3×10^{3}

d. 9.2×10^{12}

11) The monod model predicts that the specific growth rate

a. will increase with the concentration of the growth limiting substrate until it reaches a maximum value

b. will decrease with the concentration of the growth limiting substrate

c. will increase with the concentration of the growth limiting substrate

d. does not depend on growth limiting substrate

12) Mechanical agitation is required only in _____________

a. Packed bed

b. Airlift reactor

c. Stirred tank

d. Bubble column

13) . Mode of DNA replication is

a. Conservative and bidirectional

b. Semiconservative and unidirectional

c. Semiconservative and bidirectional

d. Conservative and unidirectional

14) Which enzyme is used in the unwinding of DNA?

a. Ligase

b. Topoisomerase

c. Helicase

d. Exonuclease

15) The β' subunit of polymerase has a function of _________________

a. Promoter binding

b. Elongation

c. Cation binding

d. Termination

Course Code: BTT 308

Comprehensive Course Work

MODULE 1

Microscopic techniques, Staining techniques, Microbial growth and culture media, Nutritional classes of microbes, Macro and micronutrients, sources and physiological functions of nutrients. Definition of growth; growth curve; mathematical expression of exponential growth phase; measurement of growth and growth yields; synchronous growth; effect of environmental factors on growth, growth in natural environments. Growth factors and their role in microbial metabolism. Microbes and diseases caused. Application of microbes in food and industry.

MODULE 2

Flow of incompressible fluids- Classification of flow - Steady and unsteady state flow, uniform and non-uniform flow, Laminar and Turbulent flow - Reynold's Experiment. Navier Stoke's Equation and Euler equation Newtonian and non- Newtonian fluids - Momentum flux and Newton's Law of Viscosity. Flow in boundary layers - Boundary layer separation and Wake formation. Bernoulli Equation,. Hagen-Poiseuille Equation, Laminar flow of non-Newtonian fluids, Velocity distribution for turbulent flow, Flow through packed bed - Kozney Carman equation, Motion of Particles through fluids Terminal Settling velocity, Stoke's law- Particle technology : Definition-Shape factor, mean diameter, -Sieving, microscopy, sedimentation, Particle size reduction types of size reduction equipments, factors affecting choice of equipments. Solid-liquid separation-Filtration and centrifugation,

MODULE 3

Cell structure and role of cell organelles. Biomolecules: General structure and function (monomers and polymers) . Cellular energy requirements of the cell, Glycolysis, TCA cycle, HMP pathway, transamination reaction. Chromatographic techniques: Principles of ion exchange, gel filtration and adsorption chromatography with examples. Electron transport chain, Bioenergetics, ATP and its significance, chemi-osmotic coupling, structure and function of mitochondria and cell membrane. Enzymes: Classification with examples. Mechanism of Enzyme action

MODULE 4

General requirements of a fermentation process, effect of age/size of inoculum on cell growth and product formation, Basic functions of a bioreactor, Basic bioreactor configurations, Component parts of a fermenter and their functions, Modes of bioreactor operation batch bioreactor, Advantages and Disadvantages of batch bioreactor, Continuous bioreactor Fed-batch, continuous with cell recycle, perfusion culture Medium & air sterilisation methods, del factor, batch & continuous sterilisation, thermal death kinetics of cells and spores, yield coefficient of biomass and product formation, maintenance coefficients, Models for cell kinetics-structured, unstructured, segregated and unsegregated models,

MODULE 5

Nucleic acids and their structure, Concept of gene- Split genes- introns and exons. C-value paradox., Enzymes and protein factors involved in replication. Chromosomal replication of prokaryotes and eukaryotes. Transcription and translation in prokaryotes and Eukaryotes. Different types of mutations. and repair mechanisms. Regulation of gene expression. The operon model - lactose, histidine operon, arabinose and tryptophan operon. Oncogenes and tumor suppressor genes: their significance

BTL332	DOWNSTREAM PROCESSING LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble: This would help the students to understand the various stages involved in the purification of bio molecules

Prerequisite: basic knowledge about unit operations

Course Outcomes: After the completion of the course the student will be able to

CO 1	To strengthen fundamental understanding of the unit operations involved in the separation and purification of a biological product.
CO 2	Learn various cell disruption techniques.
CO 3	Understand techniques of bulk product / protein isolation and purification.
CO 4	Acquire knowledge in biochemical engineering reactions along with purification of desired products

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO1 2
CO1	-	3	-	3	2	-	-	2	2	2	-	-
CO2	-	3	-	3	-	-	-	-	-	-	-	-
CO3	2	3	-	3	2	-	-	-	-	-	-	-
CO4		3	-	3	-	-	-	2	-	-	-	-

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks

Continuous Assessment : 30 marks

Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting): 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1): To strengthen fundamental understanding of the unit operations involved in the separation and purification of a biological product

1. Estimate the amount of total reducing sugar present in the given sample
2. Estimate the activity of invertase enzyme sample
3. determine the total amount of protein in the given protein sample

Course Outcome 2 (CO2): Learn various cell disruption techniques

1. To disrupt yeast cells by mechanical method using homogenize and estimation of total protein content by Lowry's method
2. Lyse the bacterial cells using lysozyme**.**
3. Carryout cell disruption by sonication with all relevant details

Course Outcome 3(CO3): Understand techniques of bulk product / protein isolation and purification

1. To fractionate the proteins by precipitating it using the ammonium sulphate powder.
2. Carryout Jar test to determine the optimum coagulant dosage
3. Carryout cell disruption using 50% v/v and 70% v/v acetone -sample

Course Outcome 4 (CO4): Acquire knowledge in biochemical engineering reactions along with purification of desired products

1. Carryout microfiltration with all relevant details
2. Study on Gel filtration chromatography
3. Study on Crystallization

Syllabus

A minimum of 10 experiments is Mandatory

1. Cell lysis using organic solvents
2. Cell disruption using enzymes
3. Cell lysis using Sonication
4. Determination of optimum coagulant dose for microbial cell recovery
5. Comparison of flocculating power of different flocculants
6. Determination of Isoelectric point of proteins and isolation of proteins from aqueous systems by pH change.
7. Salting out: Ammonium sulphate precipitation
8. Organic solvent mediated precipitation: Concentration of proteins from aqueous systems by addition of organic solvents
9. Aqueous two phase extraction of proteins/enzymes from aqueous systems.
10. Microfiltration
11. Study on Gel filtration chromatography
12. Study on Electrophoresis
13. Study on Crystallization

Text Books

1. P A Belter, EL Cussler, Wei-Shou Hu, *Bioseperations – Downstream Processing for Biotechnology*, Wiley, 1988.
2. B Siva Shankar, Bioseparations*: Principles and Techniques*, PHI Learning, 2005.

Reference Books

1. Juan A Aseujo, *Separation Process in Biotechnolog*y, CRC Press, 1990.
2. SatinderAhuja (Ed.), *Handbook of Bioseparations*, Volume 2, Academic Press, 2000.
3. Roger G Harrison, Paul Todd, Scott R Rudge, Demetri P Petrides, *Bioseparations Science and Engineering*, Oxford University, 2006.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Cell lysis using organic solvents	3
2	Cell disruption using enzymes	3
3	Cell lysis using Sonicaton	3
4	Determination of optimum coagulant dose for microbial cell recovery	3
5	Comparison of flocculating power of different flocculants	3
6	Determination of Isoelectric point of proteins and isolation of proteins from aqueous systems by pH change.	3
7	Salting out: Ammonium sulphate precipitation	3
8	Organic solvent mediated precipitation: Concentration of proteins from aqueous systems by addition of organic solvents	3
9	Aqueous two phase extraction of proteins/enzymes from aqueous systems.	3
10	Microfiltration	3
11	Study on Gel filtration chromatography	3
12	Study on Electrophoresis	3
13	Study on Crystallization	3

BTL334	HEAT AND MASS TRANSFER LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:
To provide students with practical knowledge of heat and mass transfer concepts in process industries

Prerequisite: Students should have basic knowledge on the concepts in heat transfer and mass transfer operations

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identification of transport properties of liquids and gases
CO 2	Analyze the transport processes and equipment
CO 3	Identify suitable equipment for the given separation
CO 4	Analyze performance of various heat transfer equipment

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	2	3	2	-	2
CO2	2	2	2	-	-	-	-	2	3	3	-	2
CO3	2	2	2	-	-	2	-	2	3	3	-	2
CO4	2	2	2	-	-	2	-	2	3	3	-	2

Assessment Pattern

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	2.5 hours

Continuous Internal Evaluation Pattern:

Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks

(b) Implementing the work/Conducting the experiment : 10 Marks

(c) Performance, result and inference (usage of equipments and troubleshooting): 25 Marks

(d) Viva voice : 20 marks

(e) Record : 5 Marks

General instructions: Practical examination to be conducted immediately after the second series test covering entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment Questions

Course Outcome 1 (CO1): Identification of transport properties of liquids and gases

1. Determination of emissivity of a surface
2. Determination of natural convection heat transfer coefficient
3. Determination of forced convection heat transfer coefficient

Course Outcome 2 (CO2): Analyze the transport processes and equipment

1. Heat transfer in composite walls – Determination of effective thermal conductivity and overall resistance
2. To verify Rayleigh's equation for batch distillation
3. Steam distillation (For example: To purify turpentine oil having high boiling point using steam distillation) Determination of steam requirement and vaporization efficiency in steam distillation

Course Outcome 3(CO3): Identify suitable equipment for the given separation

1. Leaching: simple leaching-experiment with the given solvent-solvent-inert system and compare the actual recovery with the theoretical recovery for constant solvent to feed ratio and varying the number of stages
2. Crosscurrent leaching: continuous determination of the overall stage efficiency of the continuous crosscurrent leaching unit
3. Determine the values of constants K and n for adsorption of a solute on the given adsorbent at room temperature and verify Freundlich equation

Course Outcome 4 (CO4): Analyze performance of various heat transfer equipment

1. Find overall heat transfer coefficient for the shell and tube heat exchanger at 3 different flow rates.
2. Determination of forced convection heat transfer coefficient for fins
3. Heat transfer in composite walls – Determination of effective thermal conductivity and overall resistance

Syllabus

Experiments

Heat Transfer Laboratory (A minimum of 5 experiments is Mandatory)

1. Determination of emissivity of a surface
2. Determination of natural convection heat transfer coefficient
3. Determination of forced convection heat transfer coefficient
4. Determination of forced convection heat transfer coefficient for fins
5. Determination of overall heat transfer for parallel flow and counter flow in shell and tube heat exchanger
6. Heat transfer in composite walls – Determination of effective thermal conductivity and overall resistance

Mass Transfer Laboratory (A minimum of 6 experiments is Mandatory)

1. To plot the ternary phase diagram for any ternary liquid system (For example: Acetic acid-water-toluene). To draw the tie-line and determine the plait point for ternary system
2. To verify Rayleigh's equation for batch distillation
3. Steam distillation (For example: To purify turpentine oil having high boiling point using steam distillation) Determination of steam requirement and vaporization efficiency in steam distillation
4. VLE studies (To determine VLE data for methanol-water and to compare it with literature data)
5. Leaching: simple leaching-experiment with the given solvent-solvent-inert system and compare the actual recovery with the theoretical recovery for constant solvent to feed ratio and varying the number of stages
6. Crosscurrent leaching: continuous determination of the overall stage efficiency of the continuous crosscurrent leaching unit
7. Countercurrent leaching – countercurrent leaching experiment with the given solute-solvent-inert system by batch simulation of a countercurrent cascade
8. Determine the values of constants K and n for adsorption of a solute on the given adsorbent at room temperature and verify Freundlich equation

Text Books

1. McCabe W. L., J. C. Smith and P. Harriott, *Unit Operations of Chemical Engineering*, 6/e, McGraw Hill, 2000.
2. Martin J. Rhodes, *Introduction to Particle Technology*, 2/e, John Wiley & Sons, 2008.

Reference Books

1. Coulson J. M and J. F Richardson, *Chemical Engineering: Fluid flow, Heat transfer and Mass transfer (Vol - I)*, 5/e, Butterworth-Heinemann, 1999.
2. Coulson J. M and J. F Richardson, *Chemical Engineering: Particle technology and Separation processes (Vol - II),* 5/e, Butterworth-Heinemann, 1999.
3. Perry R. H. and D.W. Green, Eds., *Perry's Chemical Engineer's Handbook*, 7/e, McGraw Hill, 1997
4. Robert E Treybal, , *Mass Transfer Operations,* 3/e McGraw Hill 1980

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Determination of emissivity of a surface	3
2	Determination of natural convection heat transfer coefficient	3
3	Determination of forced convection heat transfer coefficient	3
4	Determination of forced convection heat transfer coefficient for fins	3
5	Determination of overall heat transfer for parallel flow and counter flow in shell and tube heat exchanger	3
6	Heat transfer in composite walls – Determination of effective thermal conductivity and overall resistance	3
7	To plot the ternary phase diagram for any ternary liquid system (For example: Acetic acid-water-toluene). To draw the tie-line and determine the plait point for ternary system	3
8	To verify Rayleigh's equation for batch distillation	3
9	Steam distillation (For example: To purify turpentine oil having high boiling point using steam distillation) Determination of steam requirement and vaporization efficiency in steam distillation	3
10	VLE studies (To determine VLE data for methanol-water and to compare it with literature data)	3
11	Leaching: simple leaching-experiment with the given solvent-solvent-inert system and compare the actual recovery with the theoretical recovery for constant solvent to feed ratio and varying the number of stages	3
12	Crosscurrent leaching: continuous determination of the overall stage efficiency of the continuous crosscurrent leaching unit	3
13	Countercurrent leaching – countercurrent leaching experiment with the given solute-solvent-inert system by batch simulation	3

	of a counter current cascade	
14	Determine the values of constants K and n for adsorption of a solute on the given adsorbent at room temperature and verify Freundlich equation	3

SEMESTER VI

PROGRAM ELECTIVE I

BTT312	ANIMAL & PLANT CELL TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Required to know the structure and function of plant and animal cell

Prerequisite: Knowledge of fundamentals in plant and animal cell biology

Course Outcomes: After the completion of the course the student will be able to

CO 1	Disseminate and inculcate knowledge of various plant and animal tissue culture techniques.
CO 2	Analyse different medias for cell culture.
CO 3	Integrate biological and engineering principles in gene transfer methods
CO 4	Appraise the aspectsof various products obtained through cell culture technologies.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	2	3	2	-	-	-	3
CO 2	-	-	-	-	-	2	3	2	-	-	-	3
CO 3	-	-	-	-	-	2	3	2	-	-	-	3
CO 4	-	-	-	-	-	2	3	2	-	-	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Disseminate and inculcate knowledge of various plant and animal tissue culture techniques

1. State the applications of micropropagation.
2. Give the details about the herbicide tolerant plants.
3. Explain the concept of somaclonal variation.

Course Outcome 2 (CO2): Analyse different medias for cell culture

1. Justify the role of serum in cell culture techniques.
2. Give the details about the protoplast technology.
3. Recall the role of carbon dioxide in animal cell culture.

Course Outcome 3(CO3): Integrate biological and engineering principles in gene transfer methods

1. Explain the process of transgenic plantproduction.
2. Explain the process of coat protein mediated resistance.
3. Describe the embryonic stem cells and their applications.

Course Outcome 4 (CO4): Appraise the aspectsof various products obtained through cell culture technologies

1. Demonstrate the production of cell-culture based vaccine.
2. Give the details about the herbicide tolerant plants.
3. Describe the process of embryo rescue

Model Question Paper

			Total Pages:

Reg No.:_______________		Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT312

Course Name: ANIMAL & PLANT CELL TECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	What are the different sources of serum for animal cell culture?
	b)	Explain the significance of embryonic stem cells.
	c)	Explain the role of carbon dioxide in cell culture.
	d)	What is the significance of cell bank?
	e)	List out the applications of biodiesel
	f)	Name three microorganisms used for bioethanol production.
	g)	Give a note on Butanol fuel mixtures
	h)	What is the common feed stock materials used in biogas production?
	i)	Give a note on auto hydrolysis.
	j)	Brief about cellulose saccharification

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Explain the chemical, physical and metabolic functions of different constituents of culture medium.	(14)
		OR	
3	a)	Justify the role of carbon dioxide in animal cell culture	(7)
	b)	Describe the role of BSS	(7)
4	a)	Elaborate the methods used for measurement of viability of cell culture.	(14)
		OR	
5	a)	What are the methods for Identification of specific cell lines?	(7)

	b)	Explain the role of collagenase in tissue disaggregation.	(7)
6		Explain the methods for production of vaccines.	(14)
		OR	
7	a)	Elaborate the significance of embryonic stem cells.	(8)
	b)	Justify the role of animals as bioreactors	(6)
8		Explain the role of protoplast technology in crop improvement.	(14)
		OR	
9	a)	a) What are pathogen free plants	(7)
	b)	b) Explain the significance of somaclonal variation.	(7)
10		Explain CPMR in detail.	(14)
		OR	
11		Elaborate the role of plasmids in crop improvement	(14)
		****	

Syllabus

Module 1

Introduction to animal tissue culture: Laboratory design, aseptic conditions, methodology and media; balanced salt solution and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements. Serum & protein free defined media and their applications; Equipment and materials for animal cell culture technology

Module 2

Cell culture: Basic techniques of mammalian cell culture *in vitro*; disaggregation of tissue, primary culture establishment; maintenance of cell culture. Cell lines- characteristics and routine maintenance. Measurement of viability and cytotoxicity. Cultured cells- Biology and characterization: Characteristics of cultured cells, Cell bank, Measurement of growth parameters of cultured cells, Cell adhesion, Cell proliferation and differentiation, Identification of specific cell lines

Module 3

Biotechnological applications in animal improvement: Organ and histotypic cultures, three-dimensional culture - Tissue engineering, applications of animal cell culture- Stem cell cultures, embryonic stem cells and their applications. Cell culture-based vaccines.Improvements of animals using transgenic approach with specific examples, animals as bioreactors. Monoclonal antibodies and their commercial production.

Module 4

Plant tissue culture: History of plant tissue culture, aseptic conditions, methodology, media. Different types of culture- callus cultures, meristem cultures, anther culture, embryo culture, micro propagation, protoplast culture, somaclonal variation, synthetic seeds. Methods of plant tissue preservation and applications

Module 5

Gene Transfer methods: Agrobacterium tumefaciens mediated transfer- techniques of transferring agronomically important genes using Ti plasmid, Ri plasmid. Methods of direct gene transfer. Production of transgenic plants. Development of herbicide resistance- glyphosate, phospinothricin, sulfonyl urea, atrazine resistant transgenic plants. Virus resistance: Coat protein mediated resistance. Cell suspension cultures and bioreactor technology, secondary metabolites, Plant-derived vaccines, plant bodies. Purification of plant products and its applications. Germplasm conservation

Text Books

1. H S Chawla, Introduction to Plant Biotechnology, Science Publishers, 2002
2. Basic Cell Culture: A Practical Approach. J.M. Davis, Oxford University Press, oxford.
3. Culture of Animal Cells: A Manual of Basic Technique. R. Ian Freshney Wiley-Liss.
4. Hammond J, McGarvey P, Yusibov V (Eds), Plant Biotechnology -New Products and Applications, Springer, 1999.
5. Tong-Jen Fu, Gurmeet Singh, Wayne R. Curtis (Eds), Plant Cell and Tissue Culture for the production of Food Ingredients, Springer Science & Business Media, 1999.

Reference Books

1. Rian Freshney, Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6/e, Wiley-Blackwell, 2010.
2. John R W Masters (Ed.), Animal Cell Culture - A Practical Approach, 3/e, Oxford University Press, 2000.
3. Jackson JF, Linskens HF (Eds.), Genetic Transformation of Plants, Springer, 2003.
4. M K Razdan, Introduction to Plant tissue culture, Science Publishers, 2003.
5. Gene VII. B. Lewin. Oxford University Press, New York

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to animal tissue culture**	
1.1	Laboratory design, aseptic conditions, methodology and media; Balanced salt solution and simple growth medium	3
1.2	Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium.	
1.3	Role of carbon dioxide. Role of serum and supplements	1
1.4	Serum & protein free defined media and their applications	3
1.5	Equipment and materials for animal cell culture technology	
2	**Cell culture**	
2.1	Basic techniques of mammalian cell culture *in vitro*; disaggregation of tissue	2
2.2	Primary culture establishment; maintenance of cell culture. Cell lines- characteristics and routine maintenance. Measurement of viability and cytotoxicity.	2
2.3	Cultured cells- Biology and characterization: Characteristics of cultured cells, Cell bank	1
2.4	Measurement of growth parameters of cultured cells , Cell adhesion	
2.5	Cell proliferation and differentiation, Identification of specific cell lines	1
3	**Biotechnological applications in animal improvement**	
3.1	Organ and histotypic cultures,Three-dimensional culture - Tissue engineering, applications of animal cell culture	2
3.2	Stem cell cultures, embryonic stem cells and their applications. Cell culture-based vaccines	2
3.3	Improvements of animals using transgenic approach with specific examples	2
3.4	Animals as bioreactors. Monoclonal antibodies and their commercial production.	2
4	**Plant tissue culture**	
4.1	History of plant tissue culture, aseptic conditions, methodology, media, techniques of callus cultures	1
4.2	Meristem cultures, anther culture, embryo culture, micropropagation	2
4.3	Protoplast culture, somaclonal variation, synthetic seeds	2

4.4	Methods of plant tissue preservation and applications	1
5	**Gene Transfer methods**	
5.1	Agrobacterium tumefaciens mediated transfer- techniques of transferring agronomically important genes using Ti plasmid, Ri plasmid	2
5.2	Methods of direct gene transfer. Production of transgenic plants.	1
5.3	Development of herbicide resistance- glyphosate, phospinothricin, sulfonyl urea, atrazine resistant transgenic plants.	2
5.4	Virus resistance: Coat protein mediated resistance, Cell suspension cultures and bioreactor technology	1
5.5	Secondary metabolites, Plant-derived vaccines, plant bodies	1
5.6	Purification of plant products and its applications, Germplasm conservation	1

BTT322	ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The student should have a perfect understanding of the structure and charge related properties of biomolecules

Prerequisite: Knowledge in fundamentals of matter and properties

Course Outcomes: After the completion of the course the student will be able to

CO 1	Comprehend the principle and applications of various separation techniques.
CO 2	Identify the instruments and techniques required for the processing of samples
CO 3	Apply the concepts of bio analytical techniques in research.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	2	-	-	2	-	3		-	3
CO 2	-	-	-	2	-	-	2	-	3		-	3
CO 3	-	-	-	2	-	-	2	-	3		-	3
CO 4	-	-	-	2	-	-	2	-	3		-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Comprehend the principle and applications of various separation techniques

1. State the applications Southern blotting
2. Give the details about GC-MS.
3. Explain the principle of density gradient centrifugation

Course Outcome 2 (CO2): Identify the instruments and techniques required for the processing of samples

1. Justify the role of radioactivity sample analysis
2. Give the details of Autoradiography
3. Recall the technique of RIA

Course Outcome 3(CO3): Apply the concepts of bio analytical techniques in research

1. Explain the application of centrifugation in sample analysis
2. Explain the significance of AGE.
3. Describe the applications of blotting techniques

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT322

Course Name: ANALYTICAL TECHNIQUES IN BIOTECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	What are the different types of electrophoretic techniques?
	b)	Explain the significance of Southern Blotting.
	c)	Explain the term partition coefficient.
	d)	What is Rf value?
	e)	What do you mean by transmittance
	f)	What is the significance of A_{260}/A_{280} ratio?
	g)	Give a note on ELISA
	h)	Which are the common radioactive elements used in Biotechnology field?
	i)	Give a note on factors affecting dialysis.
	j)	Brief about radioactive disintegration

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Explain the principle and applications of photoelectric colorimeters.	(14)
		OR	
3	a)	Give the principle of IR spectroscopy.	(7)
	b)	List out the applications of UV-Vis spectrometers.	(7)
4	a)	Elaborate the technique of molecular sieving.	(14)
		OR	
5	a)	What are the principle and applications of HPLC?	(7)

	b)	Explain the technique of affinity chromatography	(7)
6		Explain the method of Immunoelectrophoresis	(14)
		OR	
7	a)	What are the principle and applications of dialysis?	(8)
	b)	Explain the role of SDS- PAGE in Biology.	(6)
8		Explain how molecular weight can be determined by sing centrifugation	(14)
		OR	
9	a)	What is density gradient centrifugation?	(7)
	b)	Explain the significance of preparative centrifuges.	(7)
10		Explain the techniques of Autoradiography	(14)
		OR	
11		Elaborate applications of radioactive techniques in Biological Science	(14)
****			

Syllabus

Module 1

Colorimetry and Spectrophotometry: The Beer-Lambert Law, transmittance and absorbance; photoelectric colorimeters; spectrophotometers types - UV-visible, IR, atomic absorption, NMR and MS.

Module 2

Chromatography: Partition chromatography - mobile and stationary phases, partition coefficient, Rf value. Paper chromatography - solvent systems, ascending and descending techniques - two dimensional chromatography – thin layer chromatography.
Column chromatography - preparation of columns - gradient elution - analysis of fraction and elution profiles.Ion exchange chromatography - preparation and activation of ion exchange materials, Affinity chromatography, Size exclusion chromatography, Gas chromatography and High Performance Liquid Chromatography (HPLC).

Module 3

Electrophoresis and Blotting Techniques: Paper and Gel electrophoresis – AGE, PAGE, SDS-PAGE, Immunoelectrophoresis – Enzyme-linked Immunosorbent Assay (ELISA), Iso-electric focusing - two dimensional electrophoresis – capillary electrophoresis.

Blotting Techniques –Southern, Northern, Western & Eastern, Immuno blotting. Dialysis-separating membranes - factors affecting dialysis, applications.

Module 4

Centrifugation: Theory of centrifugation, Types of centrifuges-preparative and analytical centrifugation. Differential centrifugation, density gradient centrifugation; analytical ultracentrifuge - determination of molecular weight.

Module 5

Radio isotope techniques: Radioactive disintegration. Detection of radioactivity - Geiger counters - labelling of biological material with radioactive isotope - scintillation counting - liquid scintillation counters, Autoradiography. Applications of radioactive techniques in Biological Science.

Text Books

1. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.8th Edition, Cambridge University Press.
2. Willard Merritand Deana Settle : *Instrumental Methods of Analysis,* CBS Publishers & Distributors.

Reference Books

1. R S Khandpur: Handbook of Analytical Instruments.3rd Edition. McGraw Hill Education(India) Pvt Ltd

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Colorimetry and Spectrophotometry**	
1.1	The Beer-Lambert Law, transmittance and absorbance	1
1.2	photoelectric colorimeters	1
1.3	spectrophotometers types - UV-visible, IR	1
1.4	Atomic absorption spectroscopy	1
1.5	NMR and MS	1

2	**Chromatography**	
2.1	Partition chromatography - mobile and stationary phases, partition coefficient, Rf value.	1
2.2	Paper chromatography - solvent systems, ascending and descending techniques	1
2.3	Two dimensional chromatography, thin layer chromatography	1
2.4	Column chromatography - preparation of columns - gradient elution - analysis of fraction and elution profiles.	2
2.5	Ion exchange chromatography - preparation and activation of ion exchange materials	1
2.6	Affinity chromatography, Size exclusion chromatography	1
2.7	Gas chromatography	1
2.8	High Performance Liquid Chromatography (HPLC)	1
3	**Electrophoresis and Blotting Techniques**	
3.1	Paper and Gel electrophoresis – AGE, PAGE, SDS-PAGE,	2
3.2	Immunoelectrophoresis – Enzyme-linked Immunosorbent Assay (ELISA), Iso-electric focusing	2
3.3	Two dimensional electrophoresis – capillary electrophoresis.	1
3.4	Blotting Techniques –Southern, Northern, Western & Eastern.	2
3.5	Immunoblotting	1
3.6	Dialysis- separating membranes - factors affecting dialysis, applications.	
4	**Centrifugation**	
4.1	Theory of centrifugation, Types of centrifuges-preparative and analytical centrifugation.	2
4.2	Differential centrifugation	1
4.3	Density gradient centrifugation	1
4.4	Analytical ultracentrifuge - determination of molecular weight	2
5	**Radio isotope techniques**	
5.1	Radioactive disintegration	1

5.2	Detection of radioactivity - Geiger counters	1
5.3	Labelling of biological material with radioactive isotope	2
5.4	Scintillation counting - liquid scintillation counters	1
5.5	Autoradiography. Applications of radioactive techniques in Biological Science.	2

BTT332	CELL BIOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Introduction to Cell, Cell features and Cell functions, Basic Cellular and Molecular biology concepts, Difference between Prokaryotes and Eukaryotes, Components of cell, Chromatin structure and functions, Basics of cell death.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Infer the fundamental concepts of cellular structure and function
CO 2	Analyze, the scientific evidence underlying our current understanding of cellular processes.
CO 3	Establish an understanding of current emerging scientific fields pertaining to cell

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-		-	-	-	3		2	-	3
CO 2	-	-	-	2	-	3	-	3	-	-	-	3
CO 3	-	-	-	3	-	3	-	3	-	2	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Infer the fundamental concepts of cellular structure and function

1. Compare prokaryotic cellular features to that of eukaryotes
2. Infer the role of cellular organization
3. Systematically assess the features of cell organelles with reference to the functions

Course Outcome 2(CO2): Analyze, the scientific evidence underlying our current understanding of cellular processes.

1. Judge the reasons for Apoptosis
2. How does a cell respond to stress?
3. Analyze the reasons to have cell cycle check points

Course Outcome 3(CO3): Establish an understanding of current emerging scientific fields pertaining to cell

1. Evaluate the recently employed experimental methods used in the study of cell death
2. Critically assess the reasons to understand complexity of cell death
3. How is stem cell important in Medical Field?

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT332

Course Name: CELL BIOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Differentiate animal and plant cells with reference to its cellular structure and functions
	b)	Define Fluid mosaic model. Discuss on the structure and functions of cell membrane.
	c)	Assess the role and capability of Ribosome
	d)	Generate reasons to prove that membrane selectivity is necessary for cellular functions. Explain in detail the process involved in selection of molecules
	e)	Justify the need for membrane transport mechanisms in a living system
	f)	Categorize the events in cell motility with the aid of neat and labelled diagram
	g)	Defend the statement "Role of Chloroplast is inevitable for existence of life"
	h)	Recognise and sketch the structural and functional importance of cell wall
	i)	Define Meiosis. How is it different from Mitosis
	j)	Present Tissue homeostasis as a significant cell function event

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Prioritize Nucleotide structure and functions as perquisite for life	(10)
	b)	Sketch and explain Extracellular matrix and its functions	(4)
		OR	
3	a)	Critically evaluate Aerobic respiration	(8)
	b)	Sketch and narrate the features of Mitochondria	(6)
4	a)	Organize the involvement and functioning of actin and myosin in cell movement with a neat and labelled sketch	(8)

	b)	Encompass Cell signalling as one of the most significant cellular mechanism	(6)
		OR	
5	a)	Organize eukaryotic chromatin with a neat and labelled diagram	(8)
	b)	Define heterochromatin. How is it different from euchromatin	(6)
6		Define Apoptosis. Discuss in detail the process involved in Apoptosis	(14)
		OR	
7		Define Necrosis. Discuss in detail the process involved in Necrosis	(14)
8		Investigate on the experimental methods used in study of cell death	(14)
		OR	
9	a)	Illustrate the Ultrastructure of prokaryotes	(14)
10		Compare the cellular features of eukaryotes to that of prokaryotes	(14)
		OR	
11	b)	Detail the DNA repair giving explanation on individual events	(14)
		****	

Syllabus

Module 1: Cell chemistry

Introduction, Ultra structure, Prokaryotes & Eukaryotes, Plant & Animal cell, Extracellular matrix, Structure and function of the plasma membrane, Structural components of Cell wall, Amino acids as subunits of proteins, Nucleotide structure and function

Module 2: Cellular Organization and specialization

Cell organelles- Cytoplasm, Mitochondria- Aerobic respiration, Golgi complex, Rough and Smooth Endoplasmic reticulum, Ribosome's, Lysosome's, Cytoskeleton, Chloroplast for Photosynthesis

Module 3: Cytoskeleton and cell motility, Cell signalling

Receptors and Messengers, Cytoskeletal fibers, Microtubules, Filaments, Actin, Myosin and cell movement, Membrane transport- Active, Passive, Membrane selectivity

Module 4: Chromatin structure

Levels of packing, Heterochromatin, Euchromatin, Structural organization of chromatin structures in prokaryotes and eukaryotes, Cell cycle- Mitosis, Meiosis, Checkpoints of cell cycle, Chromatin and DNA repair.

Module 5: Cell Death and stress response

Apoptosis, Necrosis, Cell differentiation and specialization, Cellular stress response, Stem Cells, Cancer, and Tissue Homeostasis, Complexity of cell death, Experimental methods used in the study of cell death

Text Books

1. Molecular Cell Biology, 8 th Edition, by H. Lodish et al. (W.H. Freeman & Co.) Jean-Michel Claverie, Cedric Notredame, Bioinformatics *for Dummies*, Wiley Publishing Inc., 2007.
2. The Cell: A Molecular Approach (7th Edition Geoffrey M. Cooper, Robert E. Hausman.
3. Alberts B, Bray D, Johnson A et al. (1997) Essential Cell Biology. London: Garland Publishing.

Reference Books

1. Madigan MT, Martinko JM & Parker J (2000) Brock's Biology of Microorganisms, 9th edn. Englewood Cliffs, NJ: Prentice Hall.
2. Margulis L & Schwartz KV (1998) Five Kingdoms: An Illustrated Guide to the Phyla of Life on Earth, 3rd edn. New York: Freeman.
3. Watson JD, Hopkins NH, Roberts JW et al. (1987) Molecular Biology of the Gene, 4th edn. Menlo Park, CA: Benjamin-Cummings.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1: Cell chemistry**	
1.1	Cell chemistry- Introduction	1
1.2	Ultrastructure of Prokaryotes & Eukaryotes	
1.3	Plant & Animal cell	1
1.4	Extracellular matrix	1
1.5	Structure and function of the plasma membrane	
1.6	Structural components of Cell wall, Amino acids as subunits of proteins, Nucleotide structure and function	1
1.7	Structural components of Cell wall, Amino acids as subunits of proteins	1
1.8	Nucleotide structure and function	1
2	**Module 2: Cellular Organization and specialization**	
2.1	Cell organelles- Cytoplasm, Mitochondria	1

2.2	Aerobic respiration	
2.3	Golgi complex	1
2.4	Rough and Smooth Endoplasmic reticulum	
2.5	Ribosome’s	1
2.6	Lysosome’s	
2.7	Cytoskeleton,	
2.8	Chloroplast for Photosynthesis	1
3	**Module 3**: **Cytoskeleton and cell motility, Cell signaling**	
3.1	Messengers	1
3.2	Cell signalling	1
3.3	Receptors	
3.4	Cytoskeletal fibers	1
3.5	Microtubules	2
3.6	Filaments	
3.7	Actin, Myosin	1
3.8	Cell movement Membrane transport	2
3.11	Membrane selectivity	
4	**Module 4 : Chromatin structure**	
4.1	Chromatin structure- Levels of packing	2
4.2	Heterochromatin, Euchromatin,	1
4.3	Structural organization of chromatin structures	
4.4	Structural organization of chromatin structures prokaryotes and eukaryotes,	2
4.5	Cell cycle- Mitosis,	1
4.6	Meiosis,	1
4.7	Checkpoints of cell cycle,	1
4.8	Chromatin and DNA repair	
5	**Module 5: Cell Death and stress response:**	
5.1	Apoptosis	2
5.2	Necrosis	
5.3	Cell differentiation and specialization,	2
5.4	Cellular stress response,	1
5.5	Stem Cells,	1
5.6	Cancer, and Tissue Homeostasis,	1
5.7	Complexity of cell death,	1
5.8	Experimental methods used in the study of cell death	1

BTT342	PROJECT ENGINEERING AND PROCESS PLANT ECONOMICS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: To impart the basic concepts of project engineering along with the plant economics.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Analyse the basic concepts in project engineering
CO 2	Identify efficient tools for planning, scheduling and commissioning of projects
CO 3	Analyse different tools of economic analysis for comparing different projects
CO 4	Evaluate the principles of accounting

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	-	-	-	-	-	-	-	-	-	2
CO 2	-	2	-	-	-	3	-	-	-	-	-	-
CO 3	-	3	2	2	-	3	-	-	-	-	-	2
CO 4	-	3	2	-	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Analyse the basic concepts in project engineering

1. Mention the scope and role of project engineer.
2. Elaborate on flow diagrams.
3. Exemplify the preliminary data required for construction projects.

Course Outcome 2 (CO2): Identify efficient tools for planning, scheduling and commissioning of projects

1. Summarize on planning and scheduling of projects.
2. Specify the codes and standards in piping designs.
3. Point out the precautions to be taken for the safety of plant designs.

Course Outcome 3(CO3): Analyse different tools of economic analysis for comparing different projects

1. Mention the time value of money and equivalence.
2. Explain the methods for determining the depreciation.
3. Classify the types of cost estimates.

Course Outcome 4 (CO4): Evaluate the principles of accounting

1. Define (i) trial balance, (ii) balance sheet, (iii) profit and loss accounts.
2. Explain the mathematical methods for profitability evaluation.
3. Specify (i) net present value index, (ii) break-even analysis and (iii) variable cost and fixed cost.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT342

Course Name: PROJECT ENGINEERING AND PROCESS PLANT ECONOMICS

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1	(a)	Classify the projects and explain the scope of project engineering.
	(b)	List the types of flow diagrams that are in common use.
	(c)	Exemplify the preliminary data required for construction projects.
	(d)	Specify the codes and standards in piping designs.
	(e)	Exemplify the basic principles of accounting.
	(f)	Point out the precautions to be taken for the safety of plant designs.
	(g)	Classify the types of cost estimates.
	(h)	Mention the time value of money and equivalence.
	(i)	Define trial balance and balance sheet.
	(j)	Specify net present value index and break-even analysis

PART B

Answer any one full question from each module. Each carries 14 marks.

2	(a)	Explain the bar chart and network techniques in planning and scheduling of projects.	(8)
	(b)	Discuss the main factors to be considered in the feasibility study of a project.	(6)
		OR	
3		Summarize on the planning and scheduling of the projects.	(14)
4		A plant layout is to be prepared for a batch process which involves process equipment such as plug flow reactor, an overhead condenser, steam heating jacket for reactor, a centrifuge and two centrifugal pumps. Discuss the factors to be considered in preparing this layout.	(14)
		OR	

5		Discuss the following with reference to a project (i) Process Design ii. Engineering Design and Drafting iii. Construction iv. Operation v. Specifications.	(14)
6	(a)	Differentiate the compound interest and continuous interest.	(8)
	(b)	Define (i) time value of money and equivalence, (ii) depreciation and taxes.	(6)
		OR	
7		Elaborate on the methods of determining the depreciation.	(14)
8		Explain the types of cost indices with an example.	(14)
		OR	
9		Discuss on the types of cost estimates and its relevance in cost estimation.	(14)
10	(a)	Elaborate on the financial ratios related to balance sheet and profit and loss account.	(8)
	(b)	Specify the aspects of break-even analysis.	(6)
		OR	
11	(a)	Discuss on the mathematical methods for profitability evaluation.	(10)
	(b)	Compare and contrast variable cost and fixed cost.	(4)
		****	

Syllabus

Module 1

Classification of Projects, Scope of project engineering - the role of project engineer - R & D - TEFR - plant location and site selection - preliminary data for construction projects -process engineering - flow diagrams - plot plans - engineering design and drafting. Planning and scheduling of projects - bar chart and network techniques - procurement operations - office procedures -contracts and contractors

Module 2

Scope of piping engineering, pipe sizing technique, Codes and standards, Piping design, thermal insulation and buildings, safety in plant design - plant constructions, start up and commissioning - Project financing - statutory sanctions

Module 3

Time value of money and equivalence - equations used in economic analysis - compound interest and continuous interest, depreciation and taxes - nature of depreciation - methods of determining depreciation- straight line - sinking fund - declining balances - double declining balance - sum of years digits and units of production methods

Module 4

Cost indices - material cost indices - labour cost indices -William's sixteenth factor - location index – Cost estimation- equipment for process plants - types of cost estimates - order of magnitude estimate - study estimate - preliminary estimate - definitive estimate - detailed estimate

Module 5

Principles of accounting - accounting definition - trial balance - balance sheet - profit and loss accounts - financial ratios related to balance sheet and profit and loss account. Profitability analysis - mathematical methods for profitability evaluation - payout time - payout time with interest - return on average investment - breakeven analysis - variable cost and fixed cost

Text Books

1. Ernest E. Ludwig, Applied project engineering and management, Gulf Pub.Co., (1988)
2. Jelen F.C., Cost and Optimization Engineering, McGraw Hill
3. Peters &Timmer Haus, Plant Design & Economics for Chemical Engineering, McGraw Hill

Reference Books

1. Rase & Barrow, Project Engineering of Process Plants, John Wiley
2. Schweyer, Process Engineering Economics, McGraw Hill

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Project Engineering**	
1.1	Classification of Projects, Scope of project engineering - the role of project engineer - R & D - TEFR - plant location and site selection	2
1.2	Preliminary data for construction projects -process engineering - flow diagrams - plot plans - engineering design and drafting.	2
1.3	Planning and scheduling of projects - bar chart and network techniques - procurement operations - office procedures - contracts and contractors	2
2	**Piping Engineering**	
2.1	Scope of piping engineering, pipe sizing technique	1
2.2	Codes and standards, Piping design, thermal insulation and	2

	buildings	
2.3	Safety in plant design - plant constructions, start up and commissioning - Project financing - statutory sanctions	2
3	**Process Plant Economics**	
3.1	Time value of money and equivalence - equations used in economic analysis	2
3.2	Compound interest and continuous interest, depreciation and taxes, nature of depreciation	2
3.3	Methods of determining depreciation- straight line - sinking fund - declining balances - double declining balance - sum of years digits and units of production methods	2
4	**Cost analysis**	
4.1	Cost indices - material cost indices - labour cost indices -William's sixteenth factor - location index	2
4.2	Cost estimation- equipment for process plants - types of cost estimates - order of magnitude estimate	3
4.3	Study estimate - preliminary estimate - definitive estimate - detailed estimate	3
5	**Principles of accounting**	
5.1	Principles of accounting - accounting definition - trial balance - balance sheet - profit and loss accounts	3
5.2	Financial ratios related to balance sheet and profit and loss account. Profitability analysis - mathematical methods for profitability evaluation	3
5.3	Payout time - payout time with interest - return on average investment - DCF rate of return - net present value - net present value index - breakeven analysis - variable cost and fixed cost	4

BTT352	BASICS IN IMMUNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Articulate applications of molecular biology in the modern world.

Prerequisite: Basics of Biochemistry

Course Outcomes: After the completion of the course the student will be able to

CO 1	Apply the knowledge of the immune system and analyse antigen-antibody interactions
CO 2	Analyze the role of the immune system in transplantation and diseases
CO 3	Understand the use of vaccines to manipulate immune system
CO 4	Apply the knowledge of immunotechnology to develop immune diagnostic kits and immune therapy

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	2	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Apply the knowledge of the types of immunity and immune system and analyse antigen-antibody interactions

1. Elaborate on the different types of immunity.
2. What are memory cells?
3. Differentiate epitopes and paratopes.

Course Outcome 2 (CO2) : Analyze the role of the immune system in transplantation and diseases

1. Explain the role of immunosuppressive drugs in transplantation
2. What do you mean by graft rejection?
3. Write notes on autoantibodies.

Course Outcome 3(CO3): Apply the knowledge of immunotechnology to develop immune diagnostic kits and immune therapy

1. Illustrate the importance Immunoelectrophoresis.
2. What is the principle of ELISA?
3. Enumerate the application of recombinant DNA technology for the study of the immune systems

Course Outcome 4 (CO4): Understand the use of vaccines to manipulate immune system

1. Comment on monoclonal antibodies
2. Elaborate on antibody based vaccines
3. Explain the mechanisms involved in DNA repair

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 352

Course Name:BASICS IN IMMUNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1	(a)	Distinguish the Innate and adaptive immunity
	(b)	What are cells involved in humoral immunity?
	(c)	Explain the important characteristics of haptens
	(d)	Write a note on B- cell activation
	(e)	Comment on the role of cytokines.
	(f)	What is IgE mediated hypersensitivity?
	(g)	Highlight on the significance of MHCs.
	(h)	Write a note on autoantibodies
	(i)	Comment on the advantages of western blot
	(j)	What are the advantages of monoclonal antibodies in vaccine production?

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Describe the structural and functional characteristics of Immunoglobulins	(14)
		OR	
3		Explain the role of cells and molecules that participate in the haematopoietic system and their roles in combating infectious agents.	(14)
4		Elaborate on the characteristics of an antigen and expalinantigen processing and presentation.	(14)
		OR	
5		Explain the role of cytokines in immune response.	(14)
6		Elaborate on the structure and functions of MHCs	(14)
		OR	
7		What are the types of Hypersensitivity reactions? Explain in detail	(14)

8		Describe pathogenic mechanisms and experimental models of autoimmune diseases	(14)
		OR	
9		Elaborate on the mechanisms involved in graft rejection	(14)
10		(a) Describe any three immune based techniques used in diagnostics	(14)
		OR	
11		Elaborate on the production methodology used for monoclonal antibodies	(14)
		****	

Syllabus

Module 1: Introduction to immunology

Overview of immune response, Types of immunity - Innate and adaptive immune defence and its components. Humoral and cell mediated immune response. Cells and organs of the immune system – structure and functions

Module 2: Antigens and Antibodies

Structure of Antigens, Antibodies - Structure, functions and classification, Haptens, Epitopes and Paratopes.Development, maturation, activation and differentiation of T-cells and B-cells; TCR; antigen-antibody reactions; antigen presenting cells; major histocompatibility complex; regulation of T-cell and B-cell responses.

Module 3: Immunity and Infection

Injury and inflammation; immune responses to infections.Activation of complement pathways.Hypersensitivity – Types.Cytokines and the role in immune response and complement system.

Module 4: Transplantation and Autoimmunity

Transplantation: Graft rejection – evidence and mechanisms of graft rejection, xenotransplantation, immunosuppressive drugs

Autoimmunity: Autoantibodies in humans – pathogenic mechanisms, experimental models of autoimmune diseases, treatment of autoimmune disorder.

Module 5: Immunotechnology

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Radioimmunoassay, Western blot.Application of recombinant DNA technology for the study of the immune systems

Monoclonal antibodies- production role and advantages of monoclonal antibodies, Preparation of vaccines

Text Books

1. Janis Kuby, Immunology,W.H Freeman & Company.
2. Roitt I.M., Brostoff J and Male D.K Immunology Mosby Publication
3. Ivan I., Immunological Methods manual, academic Press.
4. Fundamentals of Immunology: Paul W.E. (Eds.) Raven Press, New York, 1988.
5. Ashim K. Chakravarthy, Immunology, Tata McGraw-Hill, 1998.
6. Antibodies A laboratory Manual: Harlow and David Lane (1988), Cold spring harbor laboratory.

Reference Books

1. Charles Janeway, Immunobiology: The Immune System in Health and Disease, Garland Science, 2005.
2. Richard Coico, Geoffrey Sunshine, Immunology: A Short Course, John Wiley & Sons, 2007.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to immunology**	
1.1	Overview of immune response, Types of immunity - Innate and adaptive immune defence and its components.	2
1.2	Humoral and cell mediated immune response.	2
1.3	Cells and organs of the immune system – structure and functions	3
2	**Antigens and Antibodies**	
2.1	Structure of Antigens, Antibodies - Structure, functions and classification, Haptens, Epitopes and Paratopes.	2
2.2	Development, maturation, activation and differentiation of T-cells and B-cells; TCR;	2
2.3	antigen-antibody reactions; antigen presenting cells; major histocompatibility complex;	2
2.4	Regulation of T-cell and B-cell responses.	2
3	**Immunity and Infection**	
3.1	Injury and inflammation;	2
3.2	Immune responses to infections. – bacterial, fungi, viruses	3
3.3	Hypersensitivity – Types.Cytokines and the role in immune response and complement system	2
4	**Transplantation** and Autoimmunity	
4.1	**Transplantation**: Graft rejection – evidence and mechanisms of graft rejection, xenotransplantation, immunosuppressive drugs	3
4.2	**Autoimmunity:** Autoantibodies in humans – pathogenic mechanisms, experimental models of autoimmune diseases, treatment of autoimmune disorder.	3

5	**Immunotechnology**	
5.1	Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, Radioimmunoassay, Western blot.	2
5.2	Application of recombinant DNA technology for the study of the immune systems	1
5.3	Monoclonal antibodies- production role and advantages of monoclonal antibodies, Preparation of vaccines	3

BTT362	BIOSTATISTICS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Required to have the very basics about probability concepts

Prerequisite: MAT 202.

This course is methodology oriented and hence no mathematical derivations are needed. It is hoped that students taking this course will get a feel for the methodologies and their importance in biotechnology. In S4, the students have studied discrete and continuous distributions and inference for mean and proportions in **MAT 202**, which is a prerequisite for this course and they are not included here. The reference book discusses a lot of methods for data analysis from various disciplines and is a good supplement to the text books.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Select an appropriate measure to study and interpret the statistical characteristics of the data.
CO 2	Find the mean, proportion and standard deviation pertaining to data arising from sampling method and assess its significance.
CO 3	Perform analysis of variance on data obtained from a designed experiment.
CO 4	To understand the relevance of non-parametric methods in studying data.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2	-	2	-	-	-	-	-	2
CO 2	3	3	3	2	-	2	-	-	-	-	-	2
CO 3	3	3	3	2	-	2	-	-	-	-	-	2
CO 4	3	3	3	2	-	2	-	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20

Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Select an appropriate measure to study and interpret the statistical characteristics of the data

1. Collection, Classification and Tabulation of data.
2. Understand the concept of Random sampling
3. Make appropriate representative diagrams from the collected data

Course Outcome 2 (CO2): Find the mean, proportion and standard deviation pertaining to data arising from sampling method and assess its significance

1. Understand the need and significance of standard deviation in the data collected from biological experiments.
2. Understand the need of point and interval estimation.
3. Analyse and comparison of the attained values and assessing its significance.

Course Outcome 3(CO3): Perform analysis of variance on data obtained from a designed experiment

1. Explain the principles behind designs of experiments.
2. Understand and analyse the different types of data collected.
3. Describe the embryonic stem cells and their applications.

Course Outcome 4 (CO4): To understand the relevance of non-parametric methods in studying data

1. Use and application of different types of correlations.
2. Understand the basic concepts of regression.
3. Carry out the analysis form different kinds of data retrieved

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:___________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT362

Course Name: BIOSTATISTICS

Max. Marks: 100 | Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Explain Pi-chart with a suitable example.
	b)	Compare graphical and diagrammatic representation of data.
	c)	How is standard error related to standard deviation?
	d)	What are the statistics for ‘t’ and ‘F’ distributions?
	e)	Explain the interpretations from scatter diagram.
	f)	Define linear regression.
	g)	Give two uses of ANOVA.
	h)	What is Completely Randomised Design?
	i)	Explain briefly test for Goodness of fit.
	j)	Define Spearman’s rank correlation.

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Detail on various random sampling techniques.	(10)
	b)	What is a frequency polygon?	(4)
		OR	
3	a)	Elaborate on histogram.	(8)
	b)	Which are the different methods of collection of data?	(6)
4	a)	Detail on mean, median and mode.	(8)
	b)	How is quartile deviation calculated?	(6)
		OR	

5	a)	Define central tendency. Which are various measures of central tendency?	(8)
	b)	Which are the different types of variables?	(6)
6	a)	Calculate the correlation coefficient for the data: X:11.1 10.3 12 15.1 13.7 18.5 17.3 14.2 Y: 10.9 14.2 13.8 21.5 13.2 21.1 16.4 19.3	(14)
		OR	
7	a)	Given that 14 x + 12 y – 3 =0 and 12 x + 21 y +10 =0 are the regression lines. Identify the lines and find the correlation coefficient.	(10)
	b)	Explain 3 properties of correlation and regression.	(4)
8		The three drying techniques for curing a glue were studied and the following times (in minutes) were observed:	(14)

Formula A	13	10	8	11	8	
Formula B	13	11	14	14		
Formula C	4	1	3	4	2	4

At α=0.01, test the hypothesis that the average times for the three formulae are same.

		OR	
9	a)	Explain randomized block design	(4)
	b)	What are the assumptions underlying ANOVA, discuss its uses	(10)
10		The following are tested some of Mendel's reported results with garden pea. Test each for goodness of fit.	(14)

Cross	Progeny	Hypothesis
a. Green x Yellow pods	(F2) 428:152	3:1
b. Violet flower x White flower	(F1) 47: 40	1:1
c. Round yellow x Wrinkled green	(F1) 31:26:27:26	1:1:1:1

		OR	
11	a)	Write short notes on sign test, Wilcoxon signed rank test, Wilcoxon rank sum or Mann-Whitney U-test, Kruskal-Wallis test	(10)
	b)	Explain Non-parametric linear regression	(4)

****

Syllabus

Module 1

Summarising and Presenting Data: Types of data, measures of location (arithmetic mean, median, mode, quantities), measures of dispersion (mean deviation, variance, range, inter-quartile range), coefficient of variation, summarising grouped data, graphical presentation, Pie chart, bar diagram, histogram, Box plot, variables in biology, softwares for statistical methods (Proprietary – SPSS, open source - R and Python). (Textbooks 1 and 3)

Module 2

Statistical Inference: Sampling designs (simple random, systematic and stratified), non-probability sampling, diagnostic tests (sensitivity, specificity and likelihood ratios), sampling distributions, standard error, t, $\chi^2$and F distributions, point and interval estimation of variance, tests for variance, determining sample size for estimation of means/ proportion. (Textbooks 1, 2 and 3)

Module 3

Correlation and Regression: Bivariate data, scatter diagram, correlation coefficient, testing and interval estimation for correlation coefficient, linear regression, lines of regression, testing and interval estimation for regression coefficient, prediction using regression, coefficient of determination, χ^2test for association (independence & homogeneity). (Textbook 1)

Module 4

Experimental designs and Analysis of variance: Principles of experimental designs One-way ANOVA, Two-way ANOVA, completely randomised design (CRD), randomised block design, checking adequacy of model, assessing normality using Q-Q plot. (Textbook 3).

Module 5

Nonparametric methods: χ^2test for goodness of fit, sign test, Wilcoxon signed rank test, Wilcoxon rank sum or Mann-Whitney U-test, Kruskal-Wallis test, Spearman’s rank correlation, Non-parametric linear regression. (Textbooks 1, 3 and 4).

Text Books

1. Antonisamy, B; Premkumar, P S and Christopher, S (2017). Principles and Practice of Biostatistics, Elsevier (Relex India Pvt. Ltd.), New Delhi.
2. Sundaram, K R; Dwivedi, S N and Sreenivas, V (2015). Medical Statistics, 2nd Edition, Wolters Kluwer India Pvt. Ltd., New Delhi.
3. Johnson, R A (2018). Miller & Freund’s Probability and Statistics for Engineers, 9th Edition, Pearson Education Ltd. India.

4. Daniel, W W and Cross, C L (2013). Biostatistics - A Foundation for Analysis in the Health Sciences, 10th Edition, John Wiley and Sons, USA.

Reference Book

1. Ott, R L and Longnecker, M (2010). An Introduction to Statistical Methods and Data Analysis, 6th Edition, Brooks/ Cole, Cengage Learning, USA.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Summarising and Presenting Data**	
1.1	Types of data, measures of location (arithmetic mean, median, mode, quantiles),	1
1.2	measures of dispersion (mean deviation, variance, range, inter-quartile range),	3
1.3	coefficient of variation, summarising grouped data, graphical presentation,	1
1.4	Pie chart, bar diagram, histogram, Box plot, variables in biology,	1
1.5	Softwares for statistical methods (Proprietary – SPSS, open source - R and Python).	2
2	**Statistical Inference**	
2.1	Sampling designs (simple random, systematic and stratified), non-probability sampling,	2
2.2	Diagnostic tests (sensitivity, specificity and likelihood ratios),	2
2.3	Sampling distributions, standard error, t, χ^2 and F distributions,	1
2.4	Point and interval estimation of variance, tests for variance,	1
2.5	Determining sample size for estimation of means/ proportion.	1
3	**Correlation and Regression**:	
3.1	Bivariate data, scatter diagram, correlation coefficient,	1
3.2	Testing and interval estimation for correlation coefficient, linear regression, lines of regression,	2
3.3	Testing and interval estimation for regression coefficient, prediction using regression, coefficient of determination,	2
3.4	χ^2 test for association (independence & homogeneity).	2
4	**Experimental designs and Analysis of variance**	

4.1	Principles of experimental designs One-way ANOVA,	1
4.2	Two-way ANOVA, completely randomised design (CRD),	2
4.3	Randomised block design, checking adequacy of model,	2
4.4	Assessing normality using Q-Q plot.	2
5	**Nonparametric methods**:	
5.1	χ^2test for goodness of fit, sign test,	1
5.2	Wilcoxon signed rank test,	1
5.3	Wilcoxon rank sum or Mann-Whitney U-test,	1
5.4	Kruskal-Wallis test,	1
5.5	Spearman's rank correlation,	1
5.6	Non-parametric linear regression.	1

SEMESTER VI

MINOR

BTT382	PROCESS VALIDATION AND QUALITY CONTROL	CATEGORY	L	T	P	CREDIT
		VAC	4	0	0	4

Preamble: To provide fundamental knowledge about modelling, tools for solving models and practices and tools of quality control

Prerequisite: Student should have a basic knowledge about mathematical equations and fundamental aspects of quality concepts.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Develop general mathematical model of a control system and apply tools for solving models.
CO 2	Design stable controllers and find suitable strategies
CO 3	Enunciate methods of quality control and management strategies
CO 4	Analyse acceptance sampling schemes and estimate population distributions.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2	-	-	2	2	-	-	2	2	2
CO 2	-	-	3	-	-	3	2	-	-	3	2	-
CO 3	-	-	-	-	-	2	2	-	-	2	-	-
CO 4	2	2	2	-		2	2	-	-	2	2	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Develop general mathematical model of a control system and apply tools for solving models

1. Derive the Laplace transform of a ramp function.
2. Differentiate between traditional and model based approach.
3. Enunciate various principles of modelling.

Course Outcome 2 (CO2): Design stable controllers and find suitable strategies

1. Compare between cascade control and inferential control.
2. Brief about tuning of multiloop PID control systems.
3. Mention the Strategies for reducing control loop Interactions

Course Outcome 3(CO3): Enunciate methods of quality control and management strategies

1. Comment on different methods of quality control.
2. What are the steps fur analysing a sample data?
3. Write a short note on quality standards.

Course Outcome 4 (CO4): Analyse acceptance sampling schemes and estimate population distributions

1. Enunciate the basis of sampling schemes.
2. Write a short note on acceptance sampling schemes for variables and attributes
3. Differentiate between DMAIC methodology and DFSS methodology

Model Question Paper

			Total Pages:

Reg No.:_______________		Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE (MINORS) EXAMINATION ________ ____ 20__

Course Code: BTT 382

Course Name: PROCESS VALIDATION AND QUALITY CONTROL

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Brief about applications of laplace transform.
	b)	State the laplace transform of a sine and cosine function.
	c)	List out the Strategies for reducing control loop Interactions.
	d)	Comment on any one multi variable control strategy.
	e)	Enunciate the concept of singular value analysis.
	f)	What are the various methodologies used in quality control.
	g)	Briefly describe the advantages of simple random sampling.
	h)	Comment about the concept of process capability.
	i)	Draw the operating characteristic curve and mention its significance.
	j)	How can you carry out rectifying inspection?

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Derive the laplace transform of a)step function b)Exponential function	(10)
	b)	List out four principles of modelling.	(4)
		OR	
3	a)	Solve the ODE 4y/dt + 3y =2 ; y(0) = 1	(8)
	b)	Compare between traditional and model based approach	(6)
4	a)	.Write short note on a) Cascade control b) Adaptive control	(10)
	b)	Differentiate between process interactions and control loop interactions	(4)
		OR	
5	a)	Enunciate inferential control configuration with the help of a neat figure	(8)
	b)	Comment on decoupling strategies.	(6)
6		Discuss the significance of Quality control chart and enunciate the various methods of quality control.	(14)
		OR	
7	a	Analyse a sample data and represent it with the help of practical example.	(14)

8	a	Enunciateprocess capability analysis with the help of case studies	(8)
	b	Discuss about potential process capability and actual process capability	(6)
		OR	
9	a)	Explain the measures of process capability	(6)
	b)	Comment on statistical hypothetical test with a practical example	(8)
10	a)	Describe in detail about DMAIC methodology and DFSS methodology	(14)
		OR	
11	a)	Discuss about various types of sampling schemes.	(6)
	b)	Differentiate between producer's risk and consumer's risk	(8)
		****	

Syllabus

Module 1:

Introduction to process control: An overview of control system design- traditional and model based approach, General modelling principles. Mathematical modelling-Development and modelling considerations for control purposes.State space modelling. Tools for solving models: Laplace Transforms: Definition of laplace transform. Laplace transforms of step, exponential, ramp, sinusoidal, cosine functions and translated functions.Solution of ODE usinglaplace transform.

Module 2:

Advanced process control: Cascade control, Inferential control, Adaptive control systems.. Process interactions and control loop interactions, Pairing of controlled and manipulated variables.Singular value analysis.Tuning of multiloop PID control systems, Decoupling and multivariable control strategies,Strategies for reducing control loop Interactions.

Module 3:

Introduction to Quality&Quality Control: Concept of quality, quality characteristics, quality standards, quality cost, concept of quality control, quality control methodology, Quality control charts, statistical methods of quality control, qualityphilosophy and management strategies.Population and sample, techniques of sampling, simplerandom sample, analysis of sample data, representation of sample data, practical example

Module 4:

Population and sample distributions, estimation of population parameters, statistical hypothetical test, practical examples. Concept of process capability, measures of process capability, potential process capability, actual process capability, process capability analysis, case studies.

Module 5:

Acceptance Sampling Schemes: Basis of sampling schemes, types of sampling schemes, acceptance sampling schemes for variables and attributes, operating characteristic curve, producer's risk, consumer's risk, rectifying inspection. Six Sigma: Concept of six sigma, methods of six sigma, DMAIC methodology, DFSS methodology

Text Books:

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A.(2003)."Process dynamics and control," Wiley, New York
2. 2.Montgomery, D. C., Introduction to Statistical Quality Control, John Wiley &Sons, 2002

Reference Books

1. Smith, C.A. and Corripio, A.B. (1997). "Principles andpractice of automatic process control," Wiley, New York.
2. Johnson, C.D. (2006). "Process control instrumentation technology," Prentice-Hall, New Delhi
3. Dhillon, B. S., Applied Reliability and Quality: Fundamentals, methods,and Procedures, Springer, London, 2007

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to process control**	
1.1	An overview of control system design- traditional and model based approach, General modelling principles	1
1.2	Mathematical modelling- Development and modelling considerations for control purposes.	2
1.3	State space modelling.	1
1.4	Tools for solving models: Laplace Transforms: Definition of laplacetransform. Laplace transforms of step, exponential, ramp, sinusoidal, cosine and translated functions	3
1.5	Solution of ODE usinglaplace transform	2
2	**Advanced process control**	
2.1	Cascade control, Inferential control, Adaptive control systems.	2
2.2	Process interactions and control loop interactions	2
2.3	Pairing of controlled and manipulated variables	1
2.4	Singular value analysis	1

2.5	Tuning of multiloop PID control systems	1
2.6	Decoupling and multivariable control strategies	1
2.7	Strategies for reducing control loop Interactions	1
3	**Introduction to Quality&Quality Control**	
3.1	Concept of quality, quality characteristics,	1
3.2	Quality standards, quality cost, concept of quality control	1
3.3	Quality control methodology, Quality control charts	1
3.4	statistical methods of quality control, qualityphilosophy and management strategies	2
3.5	Population and sample, techniques of sampling, Simplerandom sample	2
3.6	analysis of sample data, representation of sample data, practical example	2
4	**Population and sample distributions**	1
4.1	Estimation of population parameters	1
4.2	statistical hypothetical test, practical examples	1
4.3	Concept of process capability	1
4.4	Measures of process capability,	1
4.5	Potential process capability, actual process capability	1
4.6	Process capability analysis	1
4.7	Case studies	1
5	**Acceptance Sampling Schemes**	
5.1	Basis of sampling schemes	1
5.2	Types of sampling schemes,	1
5.3	Acceptance sampling schemes for variables and attributes	1
5.4	Operating characteristic curve, producer's risk	1
5.5	Consumer's risk, rectifying inspection	1
5.6	Six Sigma: Concept of six sigma	1
5.7	Methods of six sigma, DMAIC methodology	1
5.8	DFSS methodology	1

BTT384	MOLECULAR DIAGNOSTICS & DRUG DESIGN	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: Course helps in understanding the molecular basis of diseases and techniques involved in diagnosis of diseases.

Prerequisite: Basic knowledge in Microbiology, Molecular Biology and Bioinformatics

Course Outcomes: After the completion of the course the student will be able to

CO 1	List the key historical developments in the field of molecular diagnostics
CO 2	Familiar with traditional techniques commonly used in diagnostics and molecular pathology laboratories and the underlying principles and applications, advantages and limitations of each technique.
CO 3	Identify the role and importance of molecular diagnostics such as real-time PCR, epidemiological genotyping, bio-imaging ,sequencing technologies and Automated Immunodiagnostic techniques
CO 4	Incorporate both in silico and lab based techniques as part of a combined molecular diagnostics strategy.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	3	-	-	2	-	-	-	-	-	2
CO 2	-	2	3	-	-	2	-	-	-	-	-	2
CO 3	-	2	3	2	3	2	2	-	-	-	2	1
CO 4	-	2	3	2	3	2	2	-	-	-	2	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70

Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): List the key historical developments in the field of molecular diagnostics

1. Explain about disease triad
2. compare traditional and modern diagnostic methods
3. Describe about various host defense mechanisms against pathogens

Course Outcome 2 (CO2): Familiar with traditional techniques commonly used in diagnostics and molecular pathology laboratories and the underlying principles and applications, advantages and limitations of each technique.

1. Analyse the current diagnostic sector in India and identify the various issues faced by them.
2. Discuss the OIE guidelines in diagnostics.
3. Describe the traditional methods of clinical diagnosis

Course Outcome 3(CO3): Identify the role and importance of molecular diagnostics such as real-time PCR, epidemiological genotyping, bio-imaging, sequencing technologies and Automated Immunodiagnostic techniques

1. Explain the techniques of PCR

2. What is FISH. Explain its role in diagnosis.
3. Write a note on nucleic acid based diagnosis

Course Outcome 4 (CO4): Incorporate both in silico and lab based techniques as part of a combined molecular diagnostics strategy.

1. Explain about molecular docking
2. Write a note on the history of drug discovery
3. Discuss about therapeutic proteins

Model Question Paper

			Total Pages:
Reg No.:_______________			Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE(MINORS)EXAMINATION ________ ____ 20__

Course Code: BTT384

Course Name: MOLECULAR DIAGNOSTICS & DRUG DESIGN

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Explain the mechanism of Pathogenesis
	b)	Describe about various host defence mechanisms against pathogens.
	c)	Huntington's disease (HD) is a neurological degenerative disorder. Identify various existing methods for the analysis of the disease.
	d)	Define metabolic disorders and elaborate the methods used for the diagnosis.
	e)	Blotting techniques can be used for the diagnosis of the infectious diseases. Explain.
	f)	Explain the different methods of DNA sequencing
	g)	Describe the application of DNA microarray in disease diagnosis.
	h)	Explain the existing methods for diagnosis of AIDS.
	i)	Write a note on nucleic acid based diagnosis
	j)	What are restriction enzymes. Mention its role in disease diagnosis

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Define molecular diagnostics and mention its advantages over conventional methods.	(7)
	b)	Describe the traditional methods of clinical diagnosis.	(7)
		OR	

3	a)	Discuss various molecular techniques used for the detection of genetic disorders.	(10)
	b)	Explain about disease triad	(4)
4	a)	Explain various biochemical methods used for diagnostics	(8)
	b)	Write a note on Antibody based diagnosis	(6)
		OR	
5	a)	What are monoclonal Abs. Explain its use as a diagnostic agent	(8)
	b)	Describe the role of ELISA in disease detection.	(6)
6	a)	How will you design a probe?	(7)
	b)	Write a note on real time PCR and its application in diagnostics.	(7)
		OR	
7	a	Analyse the current diagnostic sector in India and identify the various issues faced by them.	(7)
	b	Explain the role of quantum dots in diagnostics	(7)
8	a	Briefly discuss the application of single nucleotide polymorphism for detection of diseases	(8)
	b	Explain the concept of micro array technology?	(6)
		OR	
9	a)	How can we use SNP genotyping for disease diagnosis? Explain with example.	(6)
	b)	What are biosensors? Explain its role in the rapid diagnosis of diseases.	(8)
10	a)	Enumerate techniques are used in drug designing?	(14)
		OR	
11	a)	Explain the role of docking in diagnostics	(8)
	b)	Discuss the role of therapeutic proteins in diagnostics	(6)
		****	

Syllabus

Module 1

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario: Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases. Infection – mode of transmission in infections, factors predisposing to microbial pathogenicity, types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites. Metabolic& genetic disorders, Normal microbial flora of the human body, Host - Parasite relationships.

Module 2

Traditional disease diagnosis methods and tools: Sample collection method of collection, transport and processing of samples, Interpretation of results ,diagnosis of infection caused by protozoan, helminthes, bacteria, fungi (any two examples each) Diagnosis of DNA and RNA viruses-(any two each), Methods available for the diagnosis of genetic diseases and metabolic disorders.. Identifying human disease genes.Cancer- different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes.

Module 3

Molecular Diagnosis techniques: Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR, Real-Time PCR, Amino acid sequence analysis, Hybridization techniques Antibody production techniques: Polyclonal sera, monoclonal antibody production& purification, DNA, Protein extraction and analysis , PAGE and its variations, Western Blot, DNA sequencing- Principles, Methods and Instrumentation-sequencing methods in molecular diagnosis: Southern, Northern, in-situ, FISH, Advances in DNA sequencing- Microarrays– types and applications

Module 4

Automated Immunodiagnostic techniques: Introduction, Radioactive isotopes, DNA reporters, fluorogenic reporters, electro-chemiluminescent tags & label free immunoassays. Immunoassays – precipitation, agglutination hemagglutination, RIA, ELISA, RIA, MELISA and specific applications. Quantum dots. Immunohistochemistry – principle and techniques. : Role of transcriptomic, proteomic and metabolomic profiles as diagnostic markers.

Module 5

Drug design: Introduction to drug discovery and development, Drug discovery pipeline, Drug targets-membrane proteins, DNA, RNA, lead identification, high throughput screening, source of active compounds, therapeutic proteins, Computer aided drug design- in silico drug design methods, molecular docking.

Text Books

1. Medical Microbiology, Edited by Greenwood, D, Slack, R and Peutherer, J, ELST Publishers.
2. Parasitology, Chatterjee K.D, Chatterjee Medical Publishers.
3. Immunology and ImmunobiotechnologyAshim K Chakravarty, Oxford University Press, 2006

Reference Books

1. Kerns, E.H.; Di, L. Drug-Like Properties: Concepts, Structure Design and Methods: from ADME to Toxicity Optimization, Academic Press, Oxford,

2. Fundamentals of Molecular Diagnostics. David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.
3. Molecular Diagnostics: Fundamentals, Methods & Clinical applications. Lele Buckingham and Maribeth L. Flaws
4. Molecular Diagnostics for the Clinical Laboratorian 2Ed, W.B. Coleman. Humana Press.
5. Molecular Pathology in Clinical Practice, D. G. B. Leonard.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**History of diagnostics**	
1.1	History of diagnostics, Age of molecular diagnostics, Significance, Scope	1
1.2	Rise of diagnostic industry in Indian and global scenario.	
1.3	Diseases- infectious, physiological and metabolic errors, genetic basis of diseases, inherited diseases.	2
1.4	Infection – mode of transmission in infections,	2
1.5	Factors predisposing to microbial pathogenicity,	1
1.6	Types of infectious diseases- bacterial, viral, fungal, protozoans and other parasites.	1
1.7	Metabolic& genetic disorders,	1
1.8	Normal microbial flora of the human body, Host - Parasite relationships.	1
2	**Traditional disease diagnosis methods**	
2.1	Traditional disease diagnosis methods and tools:	1
2.2	Sample collection method of collection, transport and processing of samples, Interpretation of results ,	1
2.3	diagnosis of infection caused by protozoan, helminthes, bacteria, fungi (any two examples each)	1
2.4	Diagnosis of DNA and RNA viruses-(any two each),	1
2.5	Methods available for the diagnosis of genetic diseases and metabolic disorders..	1
2.6	Identifying human disease genes. Cancer- different types of cancers, genetics of cancer- oncogenes, tumour suppressor genes.	1
2.7	Identifying human disease genes.	1
2.8	Cancer- different types of cancers,	1
2.9	genetics of cancer- oncogenes, tumour suppressor genes.	1
3	**Molecular Diagnosis techniques:**	

3.1	Nucleic acid amplification methods and types of PCR: Reverse Transcriptase-PCR	1
3.2	Real-Time PCR, Amino acid sequence analysis,	1
3.3	Hybridization techniques Antibody production techniques: Polyclonal sera, monoclonal antibody production& purification,	1
3.4	DNA, Protein extraction and analysis	1
3.5	PAGE and its variations	1
3.6	Western Blot	1
3.7	DNA sequencing- Principles, Methods and Instrumentation-	1
3.8	Sequencing methods in molecular diagnosis: Southern, Northern in-situ, FISH	2
3.9	Advances in DNA sequencing- Microarrays– types and applications	2
4	**Automated Immunodiagnostic techniques:**	
4.1	Introduction, Radioactive isotopes, DNA reporters, fluorogenic reporters,	1
4.2	Electro-chemiluminescent tags & label free immunoassays.	1
4.3	Immunoassays – precipitation, agglutination hemagglutination,	1
4.4	RIA,ELISA, RIA, MELISA and specific applications.	2
4.5	Quantum dots.	1
4.6	Immunohistochemistry – principle and techniques.	1
4.7	Role of transcriptomic, proteomic and metabolomic profiles as diagnostic markers.	2
5	**Drug Design**	
5.1	Introduction to drug discovery and development	1
5.2	Drug discovery pipeline	1
5.3	Drug targets-membrane proteins, DNA, RNA, lead identification	1
5.4	High throughput screening, source of active compounds	1
5.5	Therapeutic proteins	1
5.6	Computer aided drug design- in silico drug design methods,	1
5.7	Molecular docking.	1

BTT386	ACCIDENT INVESTIGATION	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: The course deals with the investigating procedures in any accident scene and the subsequent method to analyze and try to find the circumstances as well as the evidences for the same

Prerequisite: Basic knowledge of Molecular Biology

Course Outcomes: After the completion of the course the student will be able to

CO 1	Inculcate the fundamental aspects of accident investigation and implement accident investigation procedures
CO 2	State the reasons for accident investigation
CO 3	Judge the potential sources of information
CO 4	Develop an ability to reach practical conclusions and recommendations

Mapping of course outcomes with program outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	-	3	-	-	-	-
CO2	-	-	-	-	-	3	-	3	-	2	-	-
CO3	-	-	-	-	-	3	-	3	-	-	-	2
CO4	-	-	-	-	-	3	-	3	2	2	-	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO 1): Inculcate the fundamental aspects of accident investigation and implement accident investigation procedures

1. Explain accident notification processes.
2. Brief about the steps taken to ensure safety at accident site
3. Outline the methods to prevent an accident.

Course Outcome 2 (CO 2): State the reasons for accident investigation

1. List out the sources of physical evidence in the investigation of road accidents.
2. Discuss the purpose of safety investigations.
3. Write note on the court procedures for investigators.

Course Outcome 3(CO 3): Judge the potential sources of information

1. Brief about the types of evidence.
2. Outline the principles of identifying and recording of evidence
3. Describe the site survey techniques

Course Outcome 4(CO4): Develop an ability to reach practical conclusions and recommendations

1. Discuss about DNA fingerprinting
2. Explain the purpose of an investigation report

3. Outline the structure of report and format

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH DEGREE (MINORS)EXAMINATION ________ ____ 20__

Course Code: BTT 386

Course Name: ACCIDENT INVESTIGATION

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	Write a note on Accident response.
	b)	Discuss about the roles of different interested parties.
	c)	Mention the requirements of investigation.
	d)	Explain the importance of group system of investigation.
	e)	Outline the types of evidences.
	f)	Explain about evidence photography.
	g)	What are the characteristics of analytical tools.
	h)	What are organisational accidents?
	i)	What is the purpose of an investigation report?
	j)	Discuss about the structure of a report.

PART B

Answer any one full question from each module. Each carries 14 marks.

2		Explain the evaluation procedure for the vehicles and victims.	(14)
		OR	
3		Explain the reasons for accident causation and methods in prevention.	(14)
4		Describe the methods for high profile complex and large investigations.	(14)
		OR	
5		Discuss the court procedures for investigators.	(14)

6		Explain recording or electronic reporting of evidence	(14)
		OR	
7		Explain the different steps in reaching conclusion and taking actions.	(14)
8		Brief about the application of Biotechnology in crime scenes	(14)
		OR	
9		Describe the application of analysis methods in investigation simulation.	(14)
10		Explain the molecular biology techniques in accident investigations.	(14)
		OR	
11		Describe about chemical and Bio safety programmes.	(14)
		****	

Syllabus

Module 1

Introduction to Incidents and Accidents, Accident response, Roles and responsibilities of different interested parties, Accident notification processes, Investigation site management and procedures, Health and safety at the accident site, Initial appraisal of land- and sea-based sites, The scale of the problem , Cost of accidents, Accident causation and prevention, Evaluation procedures of vehicle and the victims.

Module 2

Sources of physical evidence in the investigation of road accidents, Reporting and Investigation requirements, Legislation Investigation management, The purpose of safety investigations, Regulatory requirements, Group system of investigation, Managing high-profile, complex and large investigations, Accident pathology, Working with the media, Liaising with victims and families, Court procedures for investigators.

Module 3

Effective investigation Collection of facts and evidence, Evidence within the investigation process, Types of evidence, Principles of identifying and recording of evidence, Evidence harvesting and preservation, Evidence photography, Site survey techniques, including remote site surveys and underwater surveys, Investigative interviewing techniques, Reaching conclusions and taking action Recording evidence/electronic reporting Obtaining further help.

Module 4

Human factors in accidents, Passenger behavior, Analysis evidence, Fundamentals of analysis, Analytical approaches, Organizational accidents, Applying analysis tools, Application of analysis methods in investigation simulation, Forensic investigation of Road accidents, Application of Biotechnology in crime scene-DNA analysis, Forensic pathology, DNA fingerprinting etc.

Module 5

Developing safety recommendations, Chemical safety programs, Bio safety, Biohazards, *Molecular biology* techniques for *accident investigations,*Relations with the regulator and other parties, Developing and managing recommendations, Report writing: Purpose of an investigation report, Planning and preparation of a report, Report structure and format.

Text Books

1. James Reason, The Human contribution: Unsafe Acts, Accidents and Heroic recoveries" Ashgate Publishing Ltd, 2008
2. Dawn Woodley and Caren Byers "Biological Safety, Principles and Practices" Wiley Publishers, 2020
3. "Guidelines for investigating Process Safety Incidents" Third Edition, American Institute of Chemical Engineers and John Wiley Publications, 2019

Reference Books

1. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
2. Ted. S. Ferry "Modern accident Investigation and Analysis" IInd Edition, Wiley Publication , 1988
3. Jeffrey S Oakley "Accident Investigation Techniques" Second Edition,American Society of Safety Professionals, 2012

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Incidents and Accidents**	
1.1	Introduction to Incidents and Accidents, Accident response	1
1.2	Roles and responsibilities of different interested parties, Accident notification processes	2
1.3	Investigation site management and procedures, Health and safety at the accident site	2

1.4	Initial appraisal of land- and sea-based sites, The scale of the problem , Cost of accidents	2
1.5	Accident causation and prevention, Evaluation procedures of vehicle and the victims.	1
2	**Sources of physical evidence in the investigation of road accidents**	
2.1	Sources of physical evidence in the investigation of road accidents	1
2.2	Legislation Investigation management, The purpose of safety investigations	2
2.3	Reporting and Investigation requirements, Regulatory requirements, Group system of investigation	2
2.4	Managing high-profile, complex and large investigations, Accident pathology	2
2.5	Working with the media, Liaising with victims and families	1
2.6	Court procedures for investigators.	1
3	**Effective investigation Collection of facts and evidence**	
3.1	Effective investigation Collection of facts and evidence, Evidence within the investigation process, Types of evidence,	2
3.2	Principles of identifying and recording of evidence, Evidence harvesting and preservation	2
3.3	Evidence photography, Site survey techniques, including remote site surveys and underwater surveys,	2
3.4	Investigative interviewing techniques, Reaching conclusions and taking action	2
3.5	Recording evidence/electronic reporting Obtaining further help.	2
4	**Human factors in accidents**	
4.1	Human factors in accidents,Passenger behavior, Analysis evidence, Fundamentals of analysis, Analytical approaches, Organizational accidents	2
4.2	Applying analysis tools, Application of analysis methods in investigation simulation	2
4.3	Forensic investigation of Road accidents	2
4.4	Application of Biotechnology in crime scene-DNA analysis	2
4.5	Forensic pathology, DNA fingerprinting etc.	2
5	**Developing safety recommendations**	
5.1	Developing safety recommendations, Chemical safety programs	2
5.2	Bio safety, Biohazards, *Molecular biology* techniques for *accident investigations*	2
5.3	Relations with the regulator and other parties, Developing and	1

	managing recommendations	
5.4	Report writing: Purpose of an investigation report, Planning and preparation of a report	2
5.5	Report structure and format.	1

SEMESTER VI

HONOURS

BTT394	CLINICAL IMMUNOLOGY AND MOLECULAR MEDICINE	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: To understand the application of Immunological techniques in product development and also its application in molecular medicine**.**

Prerequisite: Basics in Immunology

Course Outcomes: After the completion of the course the student will be able to

CO 1	Have a thorough understanding of theoretical concepts of Immunology.
CO 2	Bring in skills and competence in specialized immunological techniques in the diagnosis and management of health related disorders.
CO 3	Acquire knowledge and understanding of research methods employing clinical immunological techniques for application in biomedical and clinical research

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	-	-	-	-	-	2	3	-	-	-	-	3
CO 2	-	-	-	2	-	2	3	3	-	-	-	3
CO 3	-	-	-	2	2	2	3	-	-	-	-	3

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Have a thorough understanding of theoretical concepts of Immunology

1. Describe active and passive immunity.
2. Elaborate the role of stem cells.
3. Classify immunoglobulins and justify their significance in immune system.

Course Outcome 2 (CO2): Bring in skills and competence in specialized immunological techniques in the diagnosis and management of health related disorders

1. Elaborate the significance of gene therapy.
2. Justify the techniques of physical and genetic genome mapping.
3. Present your views on antiviral therapies with suitable examples.

Course Outcome 3(CO3): Acquire knowledge and understanding of research methods employing clinical immunological techniques for application in biomedical and clinical research

1. Explain the role of mAbs as drugs.
2. Evaluate the role of RNAi in human diseases.
3. Demonstrate the applications of next generation sequencing.

Model Question Paper

			Total Pages:

Reg No.:_______________		Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B. TECH (HONORS) DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 394

Course Name: CLINICAL IMMUNOLOGY AND MOLECULAR MEDICINE

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	What is Haematopoiesis
	b)	What is the role of T cells in Immune system?
	c)	List any three primary lymphoid organs
	d)	Discuss the role of IgM.
	e)	Explain Single Nucleotide Polymorphism
	f)	What are the different ways by which physical mapping of genome can be done
	g)	How antiviral gene therapy can be performed
	h)	Give any three applications of novel gene therapy
	i)	What are next generation sequencing techniques
	j)	How stem cells are used in research purposes

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Describe the major elements of the innate immune system that provide defence against pyogenic infection.	(10)
	b)	Differentiate humoral and cell mediated immune response	(4)
		OR	

3	a)	Explain the process of haematopoiesis	(8)
	b)	What are the different classes of Immunoglobulins	(6)
4	a)	Define primary and secondary lymphoid organs. Discuss in detail the role played by each one of them.	(10)
	b)	How antibody diversity is produced	(4)
		OR	
5	a)	Explain the development of B-Lymphocytes	(8)
	b)	How classical pathway is getting activated for immune response	(6)
6		Explain how multiple gene polymorphisms can be tagged to molecular medicine	(14)
		OR	
7	a	How interaction between gene and environment lead to disease manifestation	(14)
8	a	Describe the role of gene therapy in medicine	(8)
	b	What are the different types of vehicles used in gene therapy	(6)
		OR	
9	a)	Explain the relation of RNAi with human diseases	(6)
	b)	How pharmacogenomics helps in developing novel gene therapies	(8)
10	a)	What are the different therapeutic development programmes involved in clinical trails	(14)
		OR	
11	a)	How monoclonal antibodies can be used as drugs	(6)
	b)	Explain the various applications of stem cell research	(8)

Syllabus

Module 1: History and scope of immunology, Haematopoiesis. Overview of immune response.Types of immunity- innate, acquired, passive and active.
Brief account on Immune system.Humoral and cell mediated immune response. Structure and Classification of immunoglobins.Cells and organs of the immune system.

Module 2: Introduction to Lymphatic system, Types of lymphoid organ, development and differentiation, Signalling in Lymphocyte activation. Immunogenetics, generation of antibody diversity.
The complement systems. Mechanism of complement activation

Module 3: Molecular Basis of Diseases: Human genetics relevant to molecular medicine, single nucleotide polymorphisms, multiple gene polymorphisms, single and multi-gene diseases, gene-environment interactions in disease manifestation, genetic and physical mapping of human genome and identification of diseases gene.

Module 4: Molecular Medicine Therapeutics: Gene therapy and recombinant molecules in medicine and therapeutic development, Antiviral therapies, vehicles for gene therapies, pharmacogenomics, its application and role in developing novel therapies. RNAi and human diseases, alternate splicing and human disease.

Module 5: Clinical trials, adjuvant therapies, monoclonal antibodies as drugs, nanobiotechnology and its applications in molecular medicine, drug resistance with conventional chemotherapies, next generation sequencing techniques. Stem cell research and its application in human health

Text Books

1. Prescott, Harley and Klein, *Microbiology*, McGraw Hill International Edition, 2008.
2. Pelczar M. J., E. C. E. Chan and N. R. Krieg, *Microbiology*, Tata McGraw Hill, 1993
3. Trent, R. J. Molecular Medicine: An Introductory Text. Academic Press, 2005

Reference Books

1. Littwack, G. (2008). Human Biochemistry and Disease. Academic Press.
2. Trent, R. J. (2012). Molecular Medicine, Fourth Edition: Genomics to Personalized Healthcare. Academic Press.
3. Trent, R. J. (2005). Molecular Medicine: An Introductory Text. Academic Press.
4. Liciniio, J., Wong, M. L. (2003). Pharmacogenomics: The Search for Individualized Therapies. Wiley-VCH Verlag GmbH & Co. KGaA.
5. Audet, J.,Stanford, W.andStanford,W. L. (2009) Stem cells in regenerative medicine. New York, Humana press.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module I**	
1.1	History and scope of immunology	1
1.2	Hematopoiesis	1
1.3	Overview of immune response	1
1.4	Types of immunity- innate, acquired, passive and active.	2
1.5	Brief account on Immune system. Humoral and cell mediated immune response	2
1.6	Structure and Classification of immunoglobins.	2
1.7	Cells and organs of the immune system.	1
2	**Module II**	
2.1	Introduction to Lymphatic system	1
2.2	Types of lymphoid organ development and differentiation	2
2.3	Development and differentiation	1
2.4	Signalling in Lymphocyte activation	1
2.5	Immunogenetics	1
2.6	Generation of antibody diversity	1
2.7	The complement systems. Mechanism of complement activation	1
3	**Module III**	
3.1	Human genetics relevant to molecular medicine	2
3.2	Single nucleotide polymorphisms	1
3.3	Multiple gene polymorphisms	2
3.4	Single and multi-gene diseases	1
3.5	Gene-environment interactions in disease manifestation,	1
3.6	Genetic and physical mapping of human genome and	2

	identification of diseases gene.	
4	**Module IV**	
4.1	Gene therapy and recombinant molecules in medicine and therapeutic development.	2
4.2	Antiviral therapies	2
4.3	Vehicles for gene therapies,	1
4.4	Pharmacogenomics, its application and role in developing novel therapies	2
4.5	RNAi and human diseases,	1
4.6	Alternate splicing and human disease	1
5	**Module V**	
5.1	Clinical trials	2
5.2	Adjuvant therapies	1
5.3	Monoclonal antibodies as drugs	2
5.4	Nanobiotechnology and its applications in molecular medicine	1
5.5	Drug resistance with convention chemotherapies	1
5.6	Next generation sequencing techniques.	1
5.7	Stem cell research and its application in human health	1

BTT396	HAZARDOUS WASTE MANAGEMENT	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: To introduce about waste management, treatment and disposal strategies of hazardous wastes**.**

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify and characterize Hazardous Wastes
CO 2	Differentiate the various role of stakeholders under the national legal framework
CO 3	To plan minimization strategies of hazardous wastes
CO 4	To design facilities for the storage, transport, processing and disposal of hazardous wastes

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	-	-	-	-	-	-	3	-	-	-	-	2
CO 2	-	-	-	-	-	2	3	3	-	-	-	2
CO 3	-	-	-	-	-	2	3	-	-	-	-	2
CO 4	-	-	-	-	-	2	3	-	-	-	-	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Identify and characterize Hazardous Wastes

1. What are the classifications of hazardous waste?
2. Explain about the hazardous waste designation system
3. Explain about specific and non specific sources

Course Outcome 2 (CO2): Differentiate the various role of stakeholders under the national legal framework

1. Short note on Zero waste concept.
2. Explain waste audit.
3. Discuss the role of pollution control board in hazardous waste management.

Course Outcome 3(CO3): To plan minimization strategies of hazardous wastes

1. What are the different levels of Hazardous waste minimization?
2. Write notes on Hazardous waste minimization.
3. Explain Zero waste concept.

Course Outcome 4 (CO4): To design facilities for the storage, transport, processing and disposal of hazardous wastes

1. What is meant by waste disposal?
2. Short note on generator requirements.
3. Analyze the need for ground water monitoring system

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SIXTH SEMESTER B. TECH DEGREE (HONORS)EXAMINATION _________ ____ 20__

Course Code: BTT 396
Course Name: HAZARDOUS WASTE MANAGEMENT

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1	a)	What are the characteristics of a hazardous waste?
	b)	Discuss in detail about hazardous waste designation system.
	c)	Explain about class E hazardous waste.
	d)	Why contingency plans are required in hazardous waste management?
	e)	What are the objectives of hazardous waste management rules 1989?
	f)	What are the Global initiatives taken to address hazardous waste related – problems?
	g)	Short note on deep well injection.
	h)	Write short note on the transportation of hazardous waste.
	i)	Explain prioritization of actions.
	j)	Analyze the need for environmental monitoring system.

PART B

Answer any one full question from each module. Each carries 14 marks.

2	a)	Explain Hazardous waste management rules-Indian Acts.	(7)
	b)	Explain about waste inventory preparation.	(7)
		OR	
3	a)	Elaborate on hazardous waste numbers and codes.	(5)
	b)	Explain about waste inventory preparation procedure and considerations.	(9)
4	a)	Explain the elements of an effective waste minimization program.	(7)
	b)	Explain in detail waste exchange and waste audit.	(7)
		OR	
5	a)	Explain about generator requirementsand transport requirements.	(7)
	b)	Briefly explain about contingency plans in waste management.	(7)
6	a)	Explain storage and disposal requirements of hazardous waste.	(7)
	b)	Describe hazardous waste ranking system.	(7)
		OR	

7	a)	Briefly explain waste compatibility chart	(5)
	b)	Discuss the major milestones of Basel Convention.	(9)
8	a)	Explain biological treatment of hazardous waste.	(4)
	b)	Elaborate on chemical and physical treatment of hazardous waste.	(10)
		OR	
9		Explain in detail of thermal and biological treatment of hazardous waste with an example.	(14)
10	a)	Explain in detail about ground water monitoring system.	(7)
	b)	Discuss the criteria for site selection for land disposal.	(7)
		OR	
11		What are the key components of an Engineered Landfill with the help of a neat diagram?	(14)
		****	

Syllabus

Introduction to Hazardous waste -waste identification and characterisation, waste management concepts – handling storage, transport and processing of wastes -treatment technologies –disposal techniques-secure landfills

Module 1: Introduction to Hazardous waste

Classification Of Hazardous Wastes – Hazardous Waste Designation System – Hazardous Waste Management and Handling Rules - European and Us Acts. Preparation of a Waste Inventory - Procedure and Considerations - Specific and Non Specific Sources - Hazardous Waste Numbers and Codes

Module 2: Principles of Waste Management

Principles of Waste Management-Zero Waste Concept -Hazardous Waste Minimization- Benefits – Elements of Effective Waste Minimization Programme - Waste Audit – Waste Exchange – Recycling

Module 3: Handling, storage and transportation of Hazardous waste

Handling And Storage Of Hazardous Wastes –Waste Compatibility Chart – Hazardous Waste Transport- Manifest System – Generator Requirements - Transporter Requirements Transboundary Movement of Wastes – Basal Convention. The Hazard Ranking System – Prioritization of Actions – Contingency Plans – Liabilities

Module 4: Treatment methods

Hazardous waste treatment technologies – Physical, chemical and thermal treatment of hazardous waste – Solidification – Chemical fixation – Encapsulation – Incineration

Module 5: Waste Disposal

Hazardous Waste Landfills – Site Selections – Landfill Design And Operation – Regulatory Aspects – Liner System- Cover System- Leachate Collection And Management – Environmental Monitoring System- Landfill Closure And Post Closure Care.Deep Well Injection And Its Regulatory Requirements..

Textbooks:

1. Hazardous Waste Management Charles A. Wentz. Second Edition 1995. McGraw Hill International.
2. Environmental Sciences By Daniel B. Botkin And Edward A. Keller, Wiley Student, 6th Edition- 2009.
3. Harry M. Freeman, Standard Handbook of Hazardous Waste Treatment And Disposal McGraw Hill 1997.

References:

1. Hazardous Waste (Management And Transboundary Movement) Rules, Ministry Of Environment And Forests, Government Of India, New Delhi, 1989
2. Biomedical Waste (Management And Handling) Rules, Ministry Of Environment And Forests, Government Of India, New Delhi, 1998
3. Electronic Waste Management And Handling Rules, Ministry Of Environment And Forests, Government Of India, New Delhi, 2011
4. Guidelines And Criteria For Hazardous Waste Landfills And Hazardous Waste Treatment Disposal Facilities, Central Pollution Control Board, New Delhi, 2010
5. Davis M. L. And Cornwell, D.A., Introductionto Environmental Engineering, McGraw Hill.
6. Liu I (ed). Environmental Engineers' Handbook, Lewis Publishers.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Hazardous waste**	
1.1	Classification Of Hazardous Wastes – Hazardous Waste Designation System – Hazardous Waste. - Specific and Non Specific Sources - Hazardous Waste Numbers and Codes	4

1.2	Management and Handling Rules - European and Us Acts	2
1.3	Preparation of a Waste Inventory - Procedure and Considerations	2
2	**Principles of Waste Management**	
2.1	Principles of Waste Management-Zero Waste Concept	1
2.2	Hazardous Waste Minimization - Benefits – Elements of Effective Waste Minimization Programme	4
2.3	Waste Audit – Waste Exchange – Recycling	4
3	**Handling, storage and transportation of Hazardous waste**	
3.1	Handling And Storage Of Hazardous Wastes –Waste Compatibility Chart – Hazardous..	3
3.2	Waste Transport- Manifest System – Generator Requirements - Transporter Requirements Transboundary Movement of Wastes – Basal Convention	5
3.3	The Hazard Ranking System – Prioritization of Actions – Contingency Plans – Liabilities	3
4	**Treatment Methods**	
4.1	Hazardous waste treatment technologies – Introduction	1
4.2	Physical, chemical, biological treatment methods	3
4.3	Thermal treatment of hazardous waste – Solidification – Chemical fixation – Encapsulation – Incineration	3
5	**Disposal Methods**	
	Hazardous Waste Landfills – Site Selections – Landfill Design And Operation – Regulatory Aspects – Liner System- Cover System- Leachate Collection And Management – Environmental Monitoring System- Landfill Closure And Post Closure Care	6
5.1	Deep Well Injection And Its Regulatory Requirements	4

BTT398	NUMERICAL TECHNIQUES IN BIOPROCESSES	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: To acquire knowledge of various numerical methods and techniques in bioprocesses and to integrate in engineering and technology disciplines.

Prerequisite: A basic understanding of all unit operations and unit processes and knowledge of fundamental conservation equations are compulsory

Course Outcomes: After the completion of the course the student will be able to

CO 1	Solve algebraic and transcendental equations, error analysis and approximation of functions as applied to mathematical models in process engineering.
CO 2	Choose the numerical solution techniques of interpolation in various intervals for the mathematical models of real life situations.
CO 3	Apply the numerical techniques of differentiation and integration for governing equations of physical examples pertaining to Biotechnology, Bioprocessing and other process engineering applications.
CO 4	Apply the various techniques and methods of solving ordinary and partial differential equations governing physical situations.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3		2		-	-	-	-	-	2
CO 2	3	3	3		-		-	-	-	-	-	2
CO 3	2	3	3		2		-	-	-	-	-	2
CO 4	2	2	3		-		-	-	-	-	-	2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Solve algebraic and transcendental equations, error analysis and approximation of functions as applied to mathematical models in process engineering

1. The experimental results give the concentration of an enzyme after every 10 minutes as 47.3, 51.9, 52.2, 51.8, 49.2, 51.1, 52.4, 47.1, 49.1 and 46.3. Report the concentration of the enzyme.

2. The temperature of a metal strip was measured at various time intervals during heating and the values obtained are reported as given below. If the relationship between the temperature and the time t is of the form $T = a e^{1/4} + b$. Estimate the temperature at t=6 min

Time, t(min)	1	2	3	4
Temp, T(^{0}C)	70	83	100	124

3. Waste acid from a nitrating process contains 25% HNO3, 55% H2SO4 and 20% H2O by weight. This is to be concentrated to get fortified acid containing 27% HNO3, 60% H2SO4 and 13% water. This is done by adding concentrated H2SO4 of strength 93%H2SO4 and concentrated HNO3 of strength 90% HNO3 in suitable quantities to the waste acid. If 1000 kg fortified acid is to be produced. Generate the linear

algebraic equations and calculate the kg of the various solutions mixed using Gauss elimination method

Course Outcome 2 (CO2): Choose the numerical solution techniques of interpolation in various intervals for the mathematical models of real life situations

1. Generate the divided difference table using the following set of data:

i	0	1	2	3	4
x_i	1	2	3	4	5
$f(x_i)$	0	7	26	63	124

2. Prove that $\mu\delta = \frac{1}{2}\Delta E^{-1} + \frac{1}{2}\Delta$

3. What are the conditions a cubic spline must satisfy?

Course Outcome 3(CO3): Apply the numerical techniques of differentiation and integration for governing equations of physical examples pertaining to Biotechnology, Bioprocessing and other process engineering applications

1. It is proposed to operate a batch reactor for converting a liquid phase reaction from A into R , the stoichiometry of the reaction is A $\longrightarrow$ R. The rate vs Concentration data are as given below: Use Simpson's 1/3rd rule to find the time required to drop the concentration of A from C_{A0} = 1.3 mol/l to C_{Af} = 0.3 mol/l?

C_A	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
$-r_A$	0.1	0.3	0.5	0.6	0.5	0.25	0.1	0.06	0.055

2. What is the order of truncation error in Simpson's 1/3rd rule.

3. The time(h) vs distance(km) travelled data are given below. Find the velocity at 3.5 h and acceleration at 1.5 h using the Newton's forward interpolation polynomial?

Time(h)	1.5	2.0	2.5	3.0	3.5	4.0
Distance(km)	3.375	7.0	13.625	24.0	38.875	59.0

Course Outcome 4 (CO4): Apply the various techniques and methods of solving ordinary and partial differential equations governing physical situations

1. Consider the reaction A $\longrightarrow$ R carried out in a batch reactor. The differential equation for species A is

$$\frac{dC_A}{dt} = -k\,C_A$$

The initial condition is at t=0, C_A =1 mol/m^3. The rate constant of the reaction is 1 s^{-1}. Using the Runge- Kutta fourth order method, determine the concentration of A at 3s using a step size of 1s.

2. Using the finite difference method, solve the second order one dimensional linear difference equation with the following boundary conditions

   At x=0; y=0 Dirchlet Boundary Condition

   At x=1; $\frac{dy}{dx}=1$ Neumann Boundary Condition

3. Consider a steel plate of size 15 cm x 15 cm. If 2 sides are held at 100^{0}C and the other two sides are held at 0^{0}C, what are the steady state temperature at interior points assuming grid size of 5cm x 5 cm

Model Question Paper

		Total Pages:
Reg No.:_______________		Name:___________________________
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SIXTH SEMESTER B. TECH DEGREE (HONORS) EXAMINATION ________ _____ 20__		
Course Code: BTT398		
Course Name: NUMERICAL TECHNIQUES IN BIOPROCESSES		
Max. Marks: 100		Duration: 3 Hours
PART A		
		Answer all questions, each carries 3 marks.
1	(a)	Determine the equation for y as a function of x if a straight line passing through the points (1, 10) and (8, 0.5) reference to coordinate point (x, y) means that x is the abscissa value and y is the ordinate value.
	(b)	Show that the Newton- Raphson method has a quadratic convergence.
	(c)	Show that $\mu=\frac{1}{2}(E^{1/2}+E^{-1/2})$
	(d)	Given f(2)=4, f(2.5)=5.5, find the linear interpolating polynomial using Lagrange interpolation
	(e)	Obtain the first and second differential using the Δ operator
	(f)	Derive the trapezoidal rule from Newton- Cotes formulae
	(g)	State the fourth order RK method.
	(h)	Use the Taylor series method to solve the following equation at x=0.25 and x=0.5 if the initial value y(0)=1.
	(i)	What is the general form of second order differential equation involving two

		independent variables. Classify the equations based on the value coefficients.	
	(j)	Write the difference equation corresponding to Laplace's equation	

PART B

Answer any one full question from each module. Each carries 14 marks.

2		The pH for maximum activity of β-amylase enzyme is measured six times. The results are 5.15, 5.25, 5.45, 5.20, 5.50, and 5.35. (a) What is the best estimate of the optimal pH? (b) How reliable is this value? (c) If the experiment were stopped after only the first three measurements were taken, what would be the result and its precision?	(14)
		OR	
3		A mixing unit is used for producing a mixed solution from three different streams X, Y and Z. The material balance equations resulted in three linear equations: $10X + 2Y + Z = 9$; $X + 10Y - Z = -22$; $-2X + 3Y + 10Z = 22$ Use the Gauss Jacobi's iteration method to solve these equations to find out the amount of each stream to be mixed in order obtain the required concentration solution?	(14)
4		The response equation for a process for a sinusoidal input is of the form f(x) = Sin x + Cos x. The value of the function for different values of x are given as follows:	(14)

x	10^0	20^0	30^0
fx)	1.1585	1.2817	1.3660

Construct a quadratic interpolating polynomial that fits the given data. Hence find f(π/12). Compare with the exact value.

OR

5		The data obtained from an experiment for the variation of the process variable, C(x) with x is given below. Construct an interpolating polynomial that fits the data using Gregory Newton's forward interpolation formula. Estimate the value of C(x) at 0.15, 0.25 and 0.45.	(14)

x	0	0.1	0.2	0.3	0.4	0.5
C(x)	-1.5	-1.27	-0.98	-0.63	-0.22	0.25

6		S is the specific heat of a body at a temperature θ^0C. Find the total heat required to raise the temperature of the body of weight 1 gram from 0^0C to 12^0C, using the following data of values and Simpsons $1/3^{rd}$rule	(14)

θ^0 C	0	2	4	6	8	10	12
S	1.00664	1.00543	1.00435	1.00331	1.00233	1.000149	1.00078

		OR	
7		Evaluate $\int_0^{\pi/2}\int_0^{\pi/2} Sin(x+y)\,dx\,dy$ using the trapezoidal rule and Simpson's rule. Take the value of h=o.5	(14)
8		On one side of a double pipe heat exchanger is saturated steam and water is flowing in the inner tube. The temperature of entering water is 20^0C and the velocity of water is 1 m/s. The inner diameter of the inner pipe is 2.4 cm. Under steady conditions, determine the temperature of water at the length of 5m from the inlet. The total length of the heat exchanger is 10m. Assume that the temperature does not change along the radius of the pipe. The density of water is 1000kg/m^3. The overall heat transfer based on the inside area of the inner pipe is 200W/m^{2}K and the temperature of saturated steam is 250^0C. a) Develop the unsteady state energy balance equation representing temperature profile. b) Solve the equation developed in part (a) using fourth order R-K method with a step size of 1m.	(14)
		OR	
9		Given that $$\frac{d^2y}{dx^2}+y^2\frac{dy}{dx}=x^3;\ y(1)=1;\ y^{'}(1)=1,$$ Obtain the values of y at x = 1.1(0.1)1.3 using Taylor series method of the fifth order	(14)
10		Using finite difference method, solve the given differential equation with the source term f(x) with the Dirchlet boundary conditions At x = 0; y = 0 At x = 1; y = -1 $\frac{d^2y}{dx^2}-2y=f(x) \qquad (0<x<1)$ $f(x)=4x^2-2x-4$	(14)
		OR	
11		Solve $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$ correct to two places of decimals at the nodal points of square grid using the boundary values indicated 0 10 20 30	(14)

20				40
40				50
60	60	60	60	

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Syllabus

Module 1

Solution of equations, eigenvalue problems, error analysis and approximation of functions: Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

Error analysis, Approximation of functions- Chebyshev polynomials Economic power series, Rational functions, Fourier series - Methods of fitting models to data, Empirical relations

Module 2

Interpolation and approximation: Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

Module 3

Numerical differentiation and integration: Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

Module 4

Initial value problems for ordinary differential equations: Single step methods - Taylor's series method - Euler's method - Modified Euler's method – Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

Module 5

Boundary value problems in ordinary and partial differential equations: Finite difference methods for solving second order two - point linear boundary value problems – Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Text Books

1. Ajay K Ray and Santosh K Gupta, "Mathematical Methods in Chemical And Environmental Engineering", Thomson Learning, 2nd Edition, Singapore, 2003.
2. Pradeep Ahuja, "Introduction to Numerical Methods in Chemical Engineering", Prentice Hall of India Pvt. Ltd ,New Delhi, 2010.
3. Jain. M. K, S R K Iyengar, R K Jain, "Numerical Methods for Scientific and Engineering Computation" , 6th Edition, New Age International Publishers, New Delhi, 2012.
4. Doraiswami Ramkrishna, Neal R Amudson, "Linear Operator Methods in Chemoical Engineering with Applications to Transport and Chemical Reaction Systems", Prentice Hall International Series in the Physical and Chemical Engineering Sciences, New Jersey, 1985.
5. Pushpavanam, S., "Mathematical Methods in Chemical Engineering", Prentice Hall of India Pvt. Ltd ,New Delhi, 2001.
6. Pauline M Doran, "Bioprocess Engineering principles", 2nd Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2015.
7. Veerarajan. T and Ramachandran, T, " Numerical Methods with programming in C", 2nd Edition, Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2006.
8. Burden, R.L and Faires, J.D, "*Numerical Analysis*", 9th Edition, Cengage Learning, 2016.
9. Grewal, B.S., and Grewal, J.S., "*Numerical Methods in Engineering and Science*", Khanna Publishers, 10th Edition, New Delhi, 2015.

Reference Books

1. Brian Bradie, "*A Friendly Introduction to Numerical Analysis*", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "*Applied Numerical Analysis*", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
3. Mathews, J.H. "*Numerical Methods for Mathematics, Science and Engineering*", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "*Numerical Methods for Scientists and Engineers*", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "*Introductory Methods of Numerical Analysis*", PHI Learning Pvt. Ltd, 5th Edition, 2015.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Solution of equations, Eigen value problems, error analysis and approximation of functions**	
1.1	Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method	2
1.2	Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel	2
1.3	Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.	2
1.4	Error analysis. Approximation of functions- Chebyshev polynomials Economic power series, Rational functions, Fourier series. Methods of fitting models to data. Empirical relations	3
2	**Interpolation and approximation**	
2.1	Interpolation with unequal intervals - Lagrange's interpolation	3
2.2	Newton's divided difference interpolation – Cubic Splines	3
2.3	Difference operators and relations - Interpolation with equal intervals -Newton's forward and backward difference formulae.	3
3	**Numerical differentiation and integration**	
3.1	Approximation of derivatives using interpolation polynomials	3
3.2	Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method	3
3.3	Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules	3
4	**Initial value problems for ordinary differential equations**	
4.1	Single step methods - Taylor's series method - Euler's method	3
4.2	Modified Euler's method – Fourth order Runge-Kutta method for solving first order equations	3
4.3	Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.	3
5	**Boundary value problems in ordinary and partial differential equations**	
5.1	Finite difference methods for solving second order two - point linear boundary value problems	2
5.2	Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain	3
5.3	One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method	4

COMMON COURSES

(S5 & S6)

MCN 301	DISASTER MANAGEMENT	Category	L	T	P	CREDIT	YEAR OF INTRODUCTION
		Non - Credit	2	0	0	Nil	2019

Preamble: The objective of this course is to introduce the fundamental concepts of hazards and disaster management.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Define and use various terminologies in use in disaster management parlance and organise each of these terms in relation to the disaster management cycle (Cognitive knowledge level: **Understand**).
CO2	Distinguish between different hazard types and vulnerability types and do vulnerability assessment (Cognitive knowledge level: **Understand**).
CO3	Identify the components and describe the process of risk assessment, and apply appropriate methodologies to assess risk (Cognitive knowledge level: **Understand**).
CO4	Explain the core elements and phases of Disaster Risk Management and develop possible measures to reduce disaster risks across sector and community (Cognitive knowledge level: **Apply**)
CO5	Identify factors that determine the nature of disaster response and discuss the various disaster response actions (Cognitive knowledge level: **Understand**).
CO6	Explain the various legislations and best practices for disaster management and risk reduction at national and international level (Cognitive knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2				2				2		2
CO2	2	3	2		2	2	3			3		2
CO3	2	3	2	2	2	2	3			3		2
CO4	3	3	3		2	2	3					2
CO5	3	3			2	2	3					2
CO6	3					2	3	3				2

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	Test 2 (Marks)	
Remember	**10**	**10**	**20**
Understand	**25**	**25**	**50**
Apply	**15**	**15**	**30**
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A.

Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

MCN 301 Disaster Management

Module 1

Systems of earth

Lithosphere- composition, rocks, soils; Atmosphere-layers, ozone layer, greenhouse effect, weather, cyclones, atmospheric circulations, Indian Monsoon; hydrosphere- Oceans, inland water bodies; biosphere

Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment.

Module 2

Hazard types and hazard mapping; Vulnerability types and their assessment- physical, social, economic and environmental vulnerability.

Disaster risk assessment –approaches, procedures

Module 3

Disaster risk management -Core elements and phases of Disaster Risk Management

Measures for Disaster Risk Reduction – prevention, mitigation, and preparedness.

Disaster response- objectives, requirements; response planning; types of responses.

Relief; international relief organizations.

Module 4

Participatory stakeholder engagement; Disaster communication- importance, methods, barriers; Crisis counselling

Capacity Building: Concept – Structural and Non-structural Measures, Capacity Assessment; Strengthening Capacity for Reducing Risk

Module 5

Common disaster types in India; Legislations in India on disaster management; National disaster management policy; Institutional arrangements for disaster management in India.

The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles

Reference Text Book

1. R. Subramanian, Disaster Management, Vikas Publishing House, 2018
2. M. M. Sulphey, Disaster Management, PHI Learning, 2016
3. UNDP, Disaster Risk Management Training Manual, 2016
4. United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. Explain the different types of cyclones and the mechanism of their formation
4. Explain with examples, the difference between hazard and risk in the context of disaster management
5. Explain the following terms in the context of disaster management (a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

Course Outcome 2 (CO2):

1. What is hazard mapping? What are its objectives?
2. What is participatory hazard mapping? How is it conducted? What are its advantages?
3. Explain the applications of hazard maps
4. Explain the types of vulnerabilities and the approaches to assess them

Course Outcome 3 (CO3):

1. Explain briefly the concept of ‘disaster risk’

2. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster
3. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy

Course Outcome 4 (CO4):

1. What is disaster prevention? Distinguish it from disaster mitigation giving examples

2. What are the steps to effective disaster communication? What are the barriers to communication?

3. Explain capacity building in the context of disaster management

Course Outcome 5 (CO5):

1. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction

2. Explain the importance of communication in disaster management

3. Explain the benefits and costs of stakeholder participation in disaster management

4. How are stakeholders in disaster management identified?

Course Outcome 6 (CO6):

1. Explain the salient features of the National Policy on Disaster Management in India

2. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction

3. What are Tsunamis? How are they caused?

4. Explain the earthquake zonation of India

Model Question paper

QP CODE: **PAGES:3**

Reg No:______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: MCN 301

Course Name: Disaster Management

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. What is the mechanism by which stratospheric ozone protects earth from harmful UV rays?
2. What are disasters? What are their causes?
3. What is hazard mapping? What are its objectives?
4. Explain briefly the concept of ‘disaster risk’
5. List the strategies for disaster risk management ‘before’, ‘during’ and ‘after’ a disaster
6. What is disaster prevention? Distinguish it from disaster mitigation giving examples
7. Briefly explain the levels of stakeholder participation in the context of disaster risk reduction
8. Explain the importance of communication in disaster management
9. What are Tsunamis? How are they caused?
10. Explain the earthquake zonation of India

Part B

Answer any one Question from each module. Each question carries 14 Marks

11. a. Explain the different types of cyclones and the mechanism of their formation [10]

b. Explain with examples, the difference between hazard and risk in the context of disaster management
[4]

OR

12. Explain the following terms in the context of disaster management [14]

(a) exposure (b) resilience (c) disaster risk management (d) early warning systems, (e) damage assessment (f) crisis counselling (g) needs assessment

13. a. What is participatory hazard mapping? How is it conducted? What are its advantages?

[8]

b. Explain the applications of hazard maps [6]

OR

14. Explain the types of vulnerabilities and the approaches to assess them [14]

15. a. Explain the core elements of disaster risk management [8]

b. Explain the factors that decide the nature of disaster response [6]

OR

16. a. What is disaster preparedness? Explain the components of a comprehensive disaster preparedness strategy [6]

b. Explain the different disaster response actions [8]

17. a. Explain the benefits and costs of stakeholder participation in disaster management [10]

b. How are stakeholders in disaster management identified? [4]

OR

18. a. What are the steps to effective disaster communication? What are the barriers to communication? [7]

b. Explain capacity building in the context of disaster management [7]

19. Explain the salient features of the National Policy on Disaster Management in India

[14]

OR

20. Explain the guiding principles and priorities of action according to the Sendai Framework for Disaster Risk Reduction [14]

Teaching Plan

	Module 1	5 Hours
1.1	Introduction about various Systems of earth, Lithosphere-composition, rocks, Soils; Atmosphere-layers, ozone layer, greenhouse effect, weather	1 Hour
1.2	Cyclones, atmospheric circulations, Indian Monsoon; hydrosphere-Oceans, inland water bodies; biosphere	1 Hour
1.3	Definition and meaning of key terms in Disaster Risk Reduction and Management- disaster, hazard,	1 Hour
1.4	Exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, Disaster risk management, early warning systems	1 Hour
1.5	Disaster preparedness, disaster prevention, disaster, Mitigation, disaster response, damage assessment, crisis counselling, needs assessment.	1 Hour
	Module 2	**5 Hours**
2.1	Various Hazard types, Hazard mapping; Different types of Vulnerability types and their assessment	1 Hour
2.2	Vulnerability assessment and types, Physical and social vulnerability	1 Hour
2.3	Economic and environmental vulnerability, Core elements of disaster risk assessment	1 Hour
2.4	Components of a comprehensive disaster preparedness strategy approaches, procedures	1 Hour
2.5	Different disaster response actions	1 Hour
	Module 3	**5 Hours**
3.1	Introduction to Disaster risk management, Core elements of Disaster Risk Management	1 Hour
3.2	Phases of Disaster Risk Management, Measures for Disaster Risk Reduction	1 Hour
3.3	Measures for Disaster prevention, mitigation, and preparedness.	1 Hour

3.4	Disaster response- objectives, requirements. Disaster response planning; types of responses.	1 Hour
3.5	Introduction- Disaster Relief, Relief; international relief organizations.	1 Hour
	Module 4	**5 Hours**
4.1	Participatory stakeholder engagement	1 Hour
4.2	Importance of disaster communication.	1 Hour
4.3	Disaster communication- methods, barriers. Crisis counselling	1 Hour
4.4	Introduction to Capacity Building. Concept – Structural Measures, Non-structural Measures.	1 Hour
4.5	Introduction to Capacity Assessment, Capacity Assessment; Strengthening, Capacity for Reducing Risk	1 Hour
	Module 5	**5 Hours**
5.1	Introduction-Common disaster types in India.	1 Hour
5.2	Common disaster legislations in India on disaster management	1 Hour
5.3	National disaster management policy, Institutional arrangements for disaster management in India.	1 Hour
5.4	The Sendai Framework for Disaster Risk Reduction and targets	1 Hour
5.5	The Sendai Framework for Disaster Risk Reduction-priorities for action, guiding principles	1 Hour

HUT 300	Industrial Economics & Foreign Trade	Category	L	T	P	CREDIT
		HSMC	3	0	0	3

Preamble: To equip the students to take industrial decisions and to create awareness of economic environment.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the problem of scarcity of resources and consumer behaviour, and to evaluate the impact of government policies on the general economic welfare. (Cognitive knowledge level: **Understand**)
CO2	Take appropriate decisions regarding volume of output and to evaluate the social cost of production. (Cognitive knowledge level: **Apply**)
CO3	Determine the functional requirement of a firm under various competitive conditions. (Cognitive knowledge level: **Analyse**)
CO4	Examine the overall performance of the economy, and the regulation of economic fluctuations and its impact on various sections in the society. (Cognitive knowledge level: **Analyse**)
CO5	Determine the impact of changes in global economic policies on the business opportunities of a firm. (Cognitive knowledge level: **Analyse**)

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2										3	
CO2	2	2			2	2	3				3	
CO3	2	2	1								3	
CO4	2	2	1			1					3	
CO5	2	2	1								3	

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks
	Test 1 (Marks)	**Test 2 (Marks)**	
Remember	**15**	**15**	**30**
Understand	**20**	**20**	**40**
Apply	**15**	**15**	**30**

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 hours**

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment - Test (2 numbers)	: 25 marks
Continuous Assessment - Assignment	: 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A	: 30 marks
Part B	: 70 marks

Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 3 sub-divisions and carries 14 marks.

SYLLABUS

HUT 300 Industrial Economics & Foreign Trade

Module 1 (Basic Concepts and Demand and Supply Analysis)

Scarcity and choice - Basic economic problems- PPC – Firms and its objectives – types of firms – Utility – Law of diminishing marginal utility – Demand and its determinants – law of demand – elasticity of demand – measurement of elasticity and its applications – Supply, law of supply and determinants of supply – Equilibrium – Changes in demand and supply and its effects – Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.

Module 2 (Production and cost)

Production function – law of variable proportion – economies of scale – internal and external economies – Isoquants, isocost line and producer's equilibrium – Expansion path – Technical progress and its implications – Cobb-Douglas production function - Cost concepts – Social cost: private cost and external cost – Explicit and implicit cost – sunk cost - Short run cost curves - long run cost curves – Revenue (concepts) – Shutdown point – Break-even point.

Module 3 (Market Structure)

Perfect and imperfect competition – monopoly, regulation of monopoly, monopolistic completion (features and equilibrium of a firm) – oligopoly – Kinked demand curve – Collusive oligopoly (meaning) – Non-price competition – Product pricing – Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming.

Module 4 (Macroeconomic concepts)

Circular flow of economic activities – Stock and flow – Final goods and intermediate goods - Gross Domestic Product - National Income – Three sectors of an economy- Methods of measuring national income – Inflation- causes and effects – Measures to control inflation- Monetary and fiscal policies – Business financing- Bonds and shares -Money market and Capital market – Stock market – Demat account and Trading account - SENSEX and NIFTY.

Module 5 (International Trade)

Advantages and disadvantages of international trade - Absolute and Comparative advantage theory - Heckscher - Ohlin theory - Balance of payments – Components – Balance of Payments deficit and devaluation – Trade policy – Free trade versus protection – Tariff and non-tariff barriers.

Reference Materials

1. Gregory N Mankiw, ‘Principles of Micro Economics’, Cengage Publications
2. Gregory N Mankiw, ‘Principles of Macro Economics’, Cengage Publications
3. Dwivedi D N, ‘Macro Economics’, Tata McGraw Hill, New Delhi.
4. Mithani D M, ‘Managerial Economics’, Himalaya Publishing House, Mumbai.
5. Francis Cherunilam, ‘International Economics’, McGraw Hill, New Delhi.

Sample Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Why does the problem of choice arise?
2. What are the central problems?
3. How do we solve the basic economic problems?
4. What is the relation between price and demand?
5. Explain deadweight loss due to the imposition of a tax.

Course Outcome 2 (CO2):

1. What is shutdown point?
2. What do you mean by producer equilibrium?
3. Explain break-even point;
4. Suppose a chemical factory is functioning in a residential area. What are the external costs?

Course Outcome 3 (CO3):

1. Explain the equilibrium of a firm under monopolistic competition.
2. Why is a monopolist called price maker?
3. What are the methods of non-price competition under oligopoly?

4. What is collusive oligopoly?

Course Outcome 4 (CO4):

1. What is the significance of national income estimation?
2. How is GDP estimated?
3. What are the measures to control inflation?
4. How does inflation affect fixed income group and wage earners?

Course Outcome 5 (CO5):

1. What is devaluation?
2. Suppose a foreign country imposes a tariff on Indian goods. How does it affect India’s exports?
3. What is free trade?
4. What are the arguments in favour of protection?

Model Question paper

QP CODE: **PAGES:3**

Reg No:______________ **Name :______________**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY FIFTH /SIXTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 300

Course Name: Industrial Economics & Foreign Trade

Max.Marks:100 **Duration: 3 Hours**

PART A

Answer all Questions. Each question carries 3 Marks

1. Why does an economic problem arise?

2. What should be the percentage change in price of a product if the sale is to be increased by 50 percent and its price elasticity of demand is 2?

3. In the production function Q= $2L^{1/2}K^{1/2}$ if L=36 how many units of capital are needed to produce 60 units of output?

4. Suppose in the short run AVC 4. Suppose in the short run $AVC<P<AC$. Will this firm produce or shut down? Give reason.

5. What is predatory pricing?

6. What do you mean by non- price competition under oligopoly?

7. What are the important economic activities under primary sector?

8. Distinguish between a bond and share?

9. What are the major components of balance of payments?

10. What is devaluation? **(10 x 3 = 30 marks)**

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Prepare a utility schedule showing units of consumption, total utility and marginal utility, and explain the law of diminishing marginal utility. Point out any three limitations of the law.

b) How is elasticity of demand measured according to the percentage method? How is the measurement of elasticity of demand useful for the government?

Or

12. a) Explain the concepts consumer surplus and producer surplus.

b) Suppose the government imposes a tax on a commodity where the tax burden met by the consumers. Draw a diagram and explain dead weight loss. Mark consumer surplus, producer surplus, tax revenue and dead weight loss in the diagram.

MODULE II

13. a) What are the advantages of large-scale production?

b) Explain Producer equilibrium with the help of isoquants and isocost line. What is expansion path?

Or

14. a) Explain break-even analysis with the help of a diagram.

b) Suppose the monthly fixed cost of a firm is Rs. 40000 and its monthly total variable cost is Rs. 60000.

i. If the monthly sales is Rs. 120000 estimate contribution and break-even sales.
ii. If the firm wants to get a monthly profit of Rs.40000, what should be the sales?

c) The total cost function of a firm is given as $TC=100+50Q - 11Q^2+Q^3$. Find marginal cost when output equals 5 units.

MODULE III

15. a) What are the features of monopolistic competition?

b) Explain the equilibrium of a firm earning supernormal profit under monopolistic competition.

Or

16. a) Make comparison between perfect competition and monopoly.

b) Explain price rigidity under oligopoly with the help of a kinked demand curve.

MODULE IV

17. a) How is national income estimated under product method and expenditure method?

b) Estimate GDPmp, GNPmp and National income

Private consumption expenditure	= 2000 (in 000 cores)
Government Consumption	= 500
NFIA	= -(300)
Investment	= 800
Net=exports	=700
Depreciation	= 400
Net-indirect tax	= 300

Or

18. a) What are the monetary and fiscal policy measures to control inflation?

b) What is SENSEX?

MODULE V

19. a) What are the advantages of disadvantages of foreign trade?

b) Explain the comparative cost advantage.

Or

20. a) What are the arguments in favour protection?

b) Examine the tariff and non-tariff barriers to international trade.

(5 × 14 = 70 marks)

Teaching Plan

Module 1 (Basic concepts and Demand and Supply Analysis)		7 Hours
1.1	Scarcity and choice – Basic economic problems - PPC	1 Hour
1.2	Firms and its objectives – types of firms	1 Hour
1.3	Utility – Law of diminishing marginal utility – Demand – law of demand	1 Hour
1.4	Measurement of elasticity and its applications	1 Hour
1.5	Supply, law of supply and determinants of supply	1 Hour
1.6	Equilibrium – changes in demand and supply and its effects	1 Hour
1.7	Consumer surplus and producer surplus (Concepts) – Taxation and deadweight loss.	1 Hour
Module 2 (Production and cost)		**7 Hours**
2.1	Productions function – law of variable proportion	1 Hour
2.2	Economies of scale – internal and external economies	1 Hour
2.3	producers equilibrium – Expansion path	1 Hour
2.4	Technical progress and its implications – cob Douglas Production function	1 Hour
2.5	Cost concepts – social cost: private cost and external cost – Explicit and implicit cost – sunk cost	1 Hour
2.6	Short run cost curves & Long run cost curves	1 Hour
2.7	Revenue (concepts) – shutdown point – Break-even point.	1 Hour
Module 3 (Market Structure)		**6 hours**
3.1	Equilibrium of a firm, MC – MR approach and TC – TR approach	1 Hour
3.2	Perfect competition & Imperfect competition	1 Hour
3.3	Monopoly – Regulation of monopoly – Monopolistic competition	1 Hour
3.4	Oligopoly – kinked demand curve	1 Hour
3.5	Collusive oligopoly (meaning) – Non price competition	1 Hour
3.6	Cost plus pricing – Target return pricing – Penetration, Predatory pricing – Going rate pricing – price skimming	1 Hour

Module 4 (Macroeconomic concepts)		7 Hours
4.1	Circular flow of economic activities	1 Hour
4.2	Stock and flow – Final goods and intermediate goods – Gross Domestic Product - National income – Three sectors of an economy	1 Hour
4.3	Methods of measuring national income	1 Hour
4.4	Inflation – Demand pull and cost push – Causes and effects	1 Hour
4.5	Measures to control inflation – Monetary and fiscal policies	1 Hour
4.6	Business financing – Bonds and shares – Money market and capital market	1 Hour
4.7	Stock market – Demat account and Trading account – SENSEX and NIFTY	1 Hour
Module 5 (International Trade)		**8 Hours**
5.1	Advantages and disadvantages of international trade	1 Hour
5.2	Absolute and comparative advantage theory	2 Hour
5.3	Heckscher – Ohlin theory	1 Hour
5.4	Balance of payments - components	1 Hour
5.5	Balance of payments deficit and devaluation	1 Hour
5.6	Trade policy – Free trade versus protection	1 Hour
5.7	Tariff and non tariff barriers.	1 Hour

HUT 310	Management for Engineers	Category	L	T	P	Credit
		HMC	3	0	0	3

Preamble: This course is intended to help the students to learn the basic concepts and functions of management and its role in the performance of an organization and to understand various decision-making approaches available for managers to achieve excellence. Learners shall have a broad view of different functional areas of management like operations, human resource, finance and marketing.

Prerequisite: Nil

Course Outcomes After the completion of the course the student will be able to

CO1	Explain the characteristics of management in the contemporary context (Cognitive Knowledge level: **Understand**).
CO2	Describe the functions of management (Cognitive Knowledge level: **Understand**).
CO3	Demonstrate ability in decision making process and productivity analysis (Cognitive Knowledge level: **Understand**).
CO4	Illustrate project management technique and develop a project schedule (Cognitive Knowledge level: **Apply**).
CO5	Summarize the functional areas of management (Cognitive Knowledge level: **Understand**).
CO6	Comprehend the concept of entrepreneurship and create business plans (Cognitive Knowledge level: **Understand**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				1	2	2	2		2	1	1
CO2	2				1	1		2	1	2	1	1
CO3	2	2	2	2	1							
CO4	2	2	2	2	1						2	1
CO5	2					1	1		1	2	1	
CO6		2	2	2	1	1	1	1	1	1	1	1

Abstract POs defined by National Board of Accreditation			
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

Assessment Pattern

Bloom's Category	Test 1 (Marks in percentage)	Test 2 (Marks in percentage)	End Semester Examination (Marks in percentage)
Remember	15	15	30
Understand	15	15	30
Apply	20	20	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment - Test : 25 marks

Continuous Assessment - Assignment : 15 marks

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which a student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

SYLLABUS

HUT 310 Management for Engineers (35 hrs)

Module 1 (Introduction to management Theory- 7 Hours)

Introduction to management theory, Management Defined, Characteristic of Management, Management as an art-profession, System approaches to Management, Task and Responsibilities of a professional Manager, Levels of Manager and Skill required.

Module 2 (management and organization- 5 hours)

Management Process, Planning types , Mission, Goals, Strategy, Programmes, Procedures, Organising, Principles of Organisation, Delegation, Span of Control, Organisation Structures, Directing, Leadership, Motivation, Controlling..

Module 3 (productivity and decision making- 7 hours)

Concept of productivity and its measurement; Competitiveness; Decision making process; decision making under certainty, risk and uncertainty; Decision trees; Models of decision making.

. Module 4 (project management- 8 hours)

Project Management, Network construction, Arrow diagram, Redundancy. CPM and PERT Networks, Scheduling computations, PERT time estimates, Probability of completion of project, Introduction to crashing.

Module 5 (functional areas of management- 8 hours)

Introduction to functional areas of management, Operations management, Human resources management, Marketing management, Financial management, Entrepreneurship, Business plans, Corporate social responsibility, Patents and Intellectual property rights.

References:

1. H. Koontz, and H. Weihrich, Essentials of Management: An International Perspective. 8th ed., McGraw-Hill, 2009.
2. P C Tripathi and P N Reddy, Principles of management, TMH, 4th edition, 2008.
3. P. Kotler, K. L. Keller, A. Koshy, and M. Jha, Marketing Management: A South Asian Perspective. 14th ed., Pearson, 2012.
4. M. Y. Khan, and P. K. Jain, Financial Management, Tata-McGraw Hill, 2008.
5. R. D. Hisrich, and M. P. Peters, Entrepreneurship: Strategy, Developing, and Managing a New Enterprise, 4th ed., McGraw-Hill Education, 1997.
6. D. J. Sumanth, Productivity Engineering and Management, McGraw-Hill Education, 1985.
7. K.Ashwathappa, 'Human Resources and Personnel Management', TMH, 3 rd edition, 2005.
8. R. B. Chase, Ravi Shankar and F. R. Jacobs, Operations and Supply Chain Management, 14th ed. McGraw Hill Education (India), 2015.

Sample Course Level Assessment Questions

Course Outcome1 (CO1): Explain the systems approach to management?

Course Outcome 2 (CO2): Explain the following terms with a suitable example Goal, Objective, and Strategy.

Course Outcome 3 (CO3): Mr. Shyam is the author of what promises to be a successful novel. He has the option to either publish the novel himself or through a publisher. The publisher is offering Mr. Shyam Rs. 20,000 for signing the contract. If the novel is successful, it will sell 200,000 copies. Else, it will sell 10,000 copies only. The publisher pays a Re. 1 royalty per copy. A market survey indicates that there is a 70% chance that the novel will be successful. If Mr. Shyam undertakes publishing, he will incur an initial cost of Rs. 90,000 for printing and marketing., but each copy sold will net him Rs. 2. Based on the given information and the decision analysis method, determine whether Mr. Shyam should accept the publisher’s offer or publish the novel himself.

Course Outcome 4 (CO4): Explain the concepts of crashing and dummy activity in project management.

Course Outcome 5 (CO5): Derive the expression for the Economic order quantity (EOQ)?

Course Outcome 6 (CO6): Briefly explain the theories of Entrepreneurial motivation.?

Model Question Paper

QP CODE: PAGES: 4

Reg No:_______________ Name:_________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: HUT 310

Course name: Management for Engineers

Max Marks: 100 **Duration: 3 Hours**

PART-A (Answer All Questions. Each question carries 3 marks)

1. “Management is getting things done through other.” Elaborate.

2. Comment on the true nature of management. Is it a science or an art?

3. Planning is looking ahead and controlling is looking back. Comment with suitable examples

4. Explain the process of communication?

5. Explain the hierarchy of objectives?

6. Explain the types of decisions?

7. Describe the Economic man model?

8. Explain the concepts of crashing and dummy activity in project management.

9. Differentiate the quantitative and qualitative methods in forecasting.

10. What are the key metrics for sustainability measurement? What makes the measurement and reporting of sustainability challenging?

PART-B (Answer any one question from each module)

11. a) Explain the systems approach to management. **(10)**

b) Describe the roles of a manager **(4)**

OR

12. a) Explain the 14 principles of administrative management? **(10)**

b) Explain the different managerial skills (**4)**

13. a) What are planning premises, explain the classification of planning premises. **(10)**

b) Distinguish between strategy and policy. How can policies be made effective. **(4)**

OR

14 a) Explain three motivational theories. **(9)**

b) Describe the managerial grid. **(5)**

15. a) Modern forest management uses controlled fires to reduce fire hazards and to stimulate new forest growth. Management has the option to postpone or plan a burning. In a specific forest tract, if burning is postponed, a general administrative cost of Rs. 300 is incurred. If a controlled burning is planned, there is a 50% chance that good weather will prevail and burning will cost Rs. 3200. The results of the burning may be either successful with probability 0.6 or marginal with probability 0.4. Successful execution will result in an estimated benefit of Rs. 6000, and marginal execution will provide only Rs. 3000 in benefits. If the weather is poor, burning will be cancelled incurring a cost of Rs. 1200 and no benefit. i) Develop a decision tree for the problem. (ii) Analyse the decision tree and determine the optimal course of action. **(8)**

b) Student tuition at ABC University is $100 per semester credit hour. The Education department supplements the university revenue by matching student tuition, dollars per dollars. Average class size for typical three credit course is 50 students. Labour costs are $4000 per class, material costs are $20 per student, and overhead cost are $25,000 per class. (a) Determine the total factor productivity. (b) If instructors deliver lecture 14 hours per week and the semester lasts for 16 weeks, what is the labour productivity? **(6)**

OR

16. a) An ice-cream retailer buys ice cream at a cost of Rs. 13 per cup and sells it for Rs. 20 per cup; any remaining unsold at the end of the day, can be disposed at a salvage price of Rs. 2.5 per cup. Past sales have ranged between 13 and 17 cups per day; there is no reason to believe that

sales volume will take on any other magnitude in future. Find the expected monetary value and EOL, if the sales history has the following probabilities: **(9)**

Market Size	13	14	15	16	17
Probability	0.10	0.15	0.15	0.25	0.35

b) At Modem Lumber Company, Kishore the president and a producer of an apple crates sold to growers, has been able, with his current equipment, to produce 240 crates per 100 logs. He currently purchases 100 logs per day, and each log required 3 labour hours to process. He believes that he can hire a professional buyer who can buy a better quality log at the same cost. If this is the case, he increases his production to 260 crates per 100 logs. His labour hours will increase by 8 hours per day. What will be the impact on productivity (measured in crates per labour-hour) if the buyer is hired? What is the growth in productivity in this case? **(5)**

17. a) A project has the following list of activities and time estimates:

Activity	**Time (Days)**	**Immediate Predecessors**
A	1	-
B	4	A
C	3	A
D	7	A
E	6	B
F	2	C, D
G	7	E, F
H	9	D
I	4	G, H

(a) Draw the network. (b) Show the early start and early finish times. (c) Show the critical path. **(10)**

b) An opinion survey involves designing and printing questionnaires, hiring and training personnel, selecting participants, mailing questionnaires and analysing data. Develop the precedence relationships and construct the project network. **(4)**

OR

18. a) The following table shows the precedence requirements, normal and crash times, and normal and crash costs for a construction project:

Activity	Immediate Predecessors	Required Time (Weeks)		Cost (Rs.)	
		Normal	Crash	Normal	Crash
A	-	4	2	10,000	11,000
B	A	3	2	6,000	9,000
C	A	2	1	4,000	6,000
D	B	5	3	14,000	18,000
E	B, C	1	1	9,000	9,000
F	C	3	2	7,000	8,000
G	E, F	4	2	13,000	25,000
H	D, E	4	1	11,000	18,000
I	H, G	6	5	20,000	29,000

Draw the network. (b) Determine the critical path. (c) Determine the optimal duration and the associated cost. **(10)**

b) Differentiate between CPM and PERT. **(4)**

19. a) What is meant by market segmentation and explain the process of market segmentation **(8)**

b) The Honda Co. in India has a division that manufactures two-wheel motorcycles. Its budgeted sales for Model G in 2019 are 80,00,000 units. Honda's target ending inventory is 10,00, 000 units and its beginning inventory is 12, 00, 000 units. The company's budgeted selling price to its distributors and dealers is Rs. 40, 000 per motorcycle. Honda procures all its wheels from an outside supplier. No defective wheels are accepted. Honda's needs for extra wheels for replacement parts are ordered by a separate division of the company. The company's target ending inventory is 3,00,000 wheels and its beginning inventory is 2,00,000 wheels. The budgeted purchase price is Rs. 1,600 per wheel.

(a) Compute the budgeted revenue in rupees.

(b) Compute the number of motorcycles to be produced.

Compute the budgeted purchases of wheels in units and in rupees.? **(6)**

OR

20. a) a) "Human Resource Management policies and principles contribute to effectiveness, continuity and stability of the organization". Discuss. (b) What is a budget? Explain how sales budget and production budgets are prepared? **(10)**

b) Distinguish between the following: (a) Assets and Liabilities (b) Production concept and Marketing concept (c) Needs and Wants (d) Design functions and Operational control functions in operations **(4)**

Teaching Plan

Sl.No	TOPIC	SESSION
	Module I	
1.1	Introduction to management	1
1.2	Levels of managers and skill required	2
1.3	Classical management theories	3
1.4	neo-classical management theories	4
1.5	modern management theories	5
1.6	System approaches to Management,	6
1.7	Task and Responsibilities of a professional Manager	7
	Module 2	
2.1	Management process – planning	8
2.2	Mission – objectives – goals – strategy – policies – programmes – procedures	9
2.3	Organizing, principles of organizing, organization structures	10
2.4	Directing, Leadership	11
2.5	Motivation, Controlling	12
	Module III	
3.1	Concept of productivity and its measurement Competitiveness	13
3.2	Decision making process;	14
3.3	Models in decision making	15
3.4	Decision making under certainty and risk	16
3.5	Decision making under uncertainty	17
3.6	Decision trees	18
3.7	Models of decision making.	19
	Module IV	
4.1	Project Management	20

Sl.No	TOPIC	SESSION
	Module I	
4.2	Network construction	21
4.3	Arrow diagram, Redundancy	22
4.4	CPM and PERT Networks	23
4.5	Scheduling computations	24
4.6	PERT time estimates	25
4.7	Probability of completion of project	26
4.8	Introduction to crashing	
	Module V	
5.1	Introduction to functional areas of management,	28
5.2	Operations management	29
5.3	Human resources management ,	30
5.4	Marketing management	31
5.5	Financial management	32
5.6	Entrepreneurship,	33
5.7	Business plans	34
5.8	Corporate social responsibility, Patents and Intellectual property rights	35

BTT401	PROCESS EQUIPMENT AND PLANT DESIGN	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: Enhance skills in process design and equipment design for bioprocesses

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Illustrate the basics of process plant design, flow sheeting, P & ID and plant Safety.
CO 2	Calculate the different parameters associated with the process design of heat transfer equipment such as heat exchangers, evaporators and condensers.
CO 3	Calculate the different parameters associated with the process design of mass transfer equipment such as distillation column and absorption column.
CO 4	Calculate the different parameters associated with the process design of bioreactors and the mechanical design of pressure vessels.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	2	2	1	2	2	-	-	-	-	-
CO2	3	3	3	2	1	-	1	-	1	-	-	-
CO3	3	3	3	2	-	-	1	-	1	-	-	-
CO4	3	3	3	3	1	-	1	-	1	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts in the question paper. Part A and Part B. Part A contains 2 numerical questions from module I, having 50 marks for each question. Students should answer any one. Part B contains 2 numerical questions from module II, having 50 mark for each question. Students should answer any one.

Students are permitted to use Perry's Chemical Engineer's handbook or similar data sources or attested copies of the relevant pages of Perry's Chemical Engineer's Handbook (any edition), IS Code (IS 2825, 1969), Steam Tables and attested copies of relevant charts/monographs in the examination. If originals of the above data sources are not available, photocopies shall also be used. In case of using photocopies, the hard bound form of all the above documents made as a single booklet duly attested by the faculty in-charge and the Head of the department concerned shall only be permitted in the examination hall. Signature and office seal of the above two members shall be affixed at the first and last pages of the booklet indicating the page numbers available in the booklet.

Model Question Paper

		Model question paper	**Total Pages:**
Reg No.:______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION _________, 20__

Course Code: BTT 401

Course Name: PROCESS EQUIPMENT AND PLANT DESIGN

Max. Marks: 100		Duration: 3 Hours

OPEN BOOK EXAMINATION

Students are permitted to use Perry's Chemical Engineer's handbook or similar data sources or attested copies of relevant pages of Perry's Chemical Engineer's Handbook (any edition), IS Code (IS 2825, 199), Steam Tables and attested copies of relevant charts/monographs and data tables in the examination.

PART A

Answer any one full question. Each question carries 50 marks

1		209578 kg/h of ammoniated brine leaving from an ammonia absorption column must be cooled from 40° C to 30°C using cooling water available at 20°C in a shell and tube heat exchanger. The density of ammoniated brine may be taken as 0.987 g/cm3 , its viscosity is 1.62 centipoise and the thermal conductivity is 0.49 W/ m.K Propose and sketch process design of the heat exchanger?
2		A process vessel is to be designed for the maximum operating pressure for 500 kN/m^2. The vessel has the nominal diameter of 1.2m and tangent to tangent length of 2.4m. The vessel is made of IS: 2002-1962 Grade 2B quality steel having allowable design stress value of 118 MN/m^2 at working temperature. The corrosion allowance is suggested to be 2mm for the life span expected for the vessel. The vessel is to be fabricated according to class 2 Indian standard specification which the weld joint efficiency of 0.85 a) Calculate the standard plate thickness to fabricate this vessel b) If a spherical vessel having the same diameter and thickness is fabricated with the same quality steel, estimate the maximum internal pressure the sphere will withstand safely.

PART B

Answer any one full question. Each question carries 50 marks

3		A methanol (A)- water (B) solution containing 50 wt % methanol at 26.7ºC is to be continuously rectified at 1 std atm pressure at a rate of 5000 kg/h to provide a distillate containing 95% methanol and a residue containing 1.0% methanol (by weight). The feed is to be preheated by heat exchange with the residue which will leave the system at 37.8 ºC. The distillate is to be totally condensed to a liquid and the reflux returned at bubble point. The withdrawn distillate will be separately cooled before storage. A reflux ratio of 1.5 times the minimum will be used. Determine (a) the quantity of products (b) minimum reflux ratio (c) number of theoretical stages (d) sieve tray parameters (e) check for pressure drop and liquid holdup

4		A fermenter containing $5 m^3$ of medium (27°C) is to be sterilized by passing steam (saturated) at 400 kPa (g) through the coil in the fermenter. The typical bacterial count of the medium is about $3 \times 10^{12}\ m^{-3}$ which needs to be reduced to such an extent that the chance for a contaminant surviving the sterilization is 1 in 100. The fermenter will be heated until the medium reaches 110°C. During the holding time, the heat loss through the vessel is assumed negligible. After the proper holding time, the fermenter will be cooled by passing $15\ m^3/h$ of water at 27 °C through the coil in the fermenter until the medium reaches 43°C. The coils have a heat transfer area of $45\ m^2$ and for this operation the average overall heat transfer coefficient for heating and cooling is 4500 and 3000 $W/m^2 °C$ respectively. The heat resistant bacterial spores in the medium can be characterized by Arrhenius coefficient of $5.7 \times 10^{39}\ h^{-1}$ and activation energy of 2.834×10^5 kJ/kmol. The heat capacity and density of the medium can be assumed to be equal to that of water. Determine the holding time.

Syllabus

Module I: Design and construction of a process plant- Design of heat exchange equipment's- Design and sketch of various types of evaporators- Design of pressure vessel

Overview of introduction to principles involved in the design and construction of a process plant, piping and instrumentation; General design consideration, property estimation and material and energy balance.

Design of heat exchange equipment for upstream and downstream operations in bioprocessing industries: Heat exchangers and condensers: single pipe and multi-pass shell and tube heat exchangers and condensers.

Design and drawing of various types of evaporators employed in bioprocess operation: Evaporators: Standard vertical tube evaporator, single and multiple effect evaporators.

Unfired pressure vessel: Pressure vessel codes, classification of pressure vessels, Design of cylindrical and spherical shell under internal and external pressures; Selection and design of flat plate, torispherical, ellipsoidal, and conical closures, compensations of openings.

Module II: Design of mass transfer equipment- Absorption columns- Design of fermenters- Process design of mechanically agitated fermenters

Design of mass transfer equipment for upstream and downstream operations in bioprocessing industries: Distillation columns: Detailed process design and drawing of perforated plate, bubble cap columns and packed towers.

Absorption columns: Detailed process design and drawing of perforated plate, bubble cap columns and packed towers.

Design of fermenters: Design considerations for maintaining sterility of process streams and process equipment.

Process design of mechanically agitated fermenters (STR or CSTR) and non-mechanically agitated (bubble column and air lift) fermenters.

Reference Books

1. **Perry R.H. and Green D.W,** *Chemical Engineers Handbook, McGraw Hill*
2. ***Kern* Donald Q.,** *Process Heat Transfer,* McGraw Hill
3. **Coulson J. M. and Richardson J. F. (Eds.) R.K.Sinnott,** *Chemical Engineering*, *Volume 6: An introduction to Chemical Engineering Design,*

Butterworth-Heinemann Ltd., UK. (Indian Edition: Asian Books Private Limited, New Delhi)

4. **Brownell and Young,** *Process Equipment Design-Vessel Design*, John Wiley
5. **Joshi M.V and Mahajani V.V**, *Process Equipment Design*, McMillan India Ltd, Delhi.
6. **Bhattacharya B C,** *Chemical Equipment Design*, CBS
7. **Ludwig E E, A***pplied Process Design for Chemical and Petrochemical Plants, (Vol. 1,2 and 3) ,* 3rd Ed., Gulf Publishing Company, Houston.
8. **Roger Harrison** *et al.*, *Bioseparations Science and Engineering,* Oxford University Press, 2003.
9. **Najafpour,G.D.**, *Biochemical Engineering and Biotechnology*, Elsevier, 2007.
10. **Blanch, H. W. and Clark, D. S.,** Biochemical Engineering, Marcel Dekker, Inc., 1999.
11. **Van Winkle M,** *Distillation*, Ist Ed., McGraw Hill Company, New York, 1967.
12. ***Pressure Vessel Code*** **–** IS Code 2825, B.I.S., New Delhi, 1969.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Process Plant Design**	**18**
1.1	Overview of introduction to principles involved in the design and construction of a process plant, piping and instrumentation; General design consideration	2
1.2	Property estimation and material and energy balance.	2
1.3	Design of heat exchange equipment’s for upstream and downstream operations in bioprocessing industries	3
1.4	Heat exchangers and condensers: single pipe and multi-pass shell and tube heat exchangers and condensers.	1
1.5	Design and drawing of various types of evaporators employed in bioprocess operation: Evaporators	3
1.6	Standard vertical tube evaporator, single and multiple effect evaporators	1
1.7	Unfired pressure vessel: Pressure vessel codes, classification of pressure vessels	1
1.8	Design of cylindrical and spherical shell under internal and external pressures	3
1.9	Selection and design of flat plate, torispherical, ellipsoidal, and conical closures, compensations of openings.	2
2	**Design of mass transfer equipment- Absorption columns- Design of fermenters- Process design of mechanically agitated fermenters**	**17**
2.1	Design of mass transfer equipment’s for upstream and downstream operations in bioprocessing industries	4
2.2	Distillation columns: Detailed process design and drawing of perforated plate, bubble cap columns and packed towers	3
2.3	Absorption columns: Detailed process design and drawing of perforated plate, bubble cap columns and packed towers.	4
	Design of fermenters: Design considerations for maintaining sterility of process streams and process equipment’s	3
2.4	Process design of mechanically agitated fermenters (STR or CSTR) and non-mechanically agitated (bubble column and air lift) fermenters.	3
	Total lecture hours	**35**

SEMESTER VII
PROGRAM ELECTIVE II

BTT 413	ENERGY ENGINEERING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Study in detail the different energy sources, its conversion and preservation technologies.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify different sources of energy and its preservation and also composition, classification and resources of coal.
CO 2	Understand the different types of energy sources like nuclear and solar energy and also its harvesting technologies.
CO 3	Analyse the application of wind energy and hydroelectric energy, its types, applications advantages and disadvantages.
CO 4	Understand the basics of biogas and fuel cells and also Energy conservation methodologies in chemical process plants.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12
CO 1	2	-	2	1	-	2	2	-	-		-	-
CO 2	2	-	2	1	-	-	2	-	-	-		-
CO 3	2	-	2	1	-	-	2		-	-		-
CO 4	2	-	2	1		2	3	1	-			-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions (Minimum 3 questions per CO)

Course Outcome 1 (CO1):

1. Write the different energy sources?
2. Explain energy audit and conservation.
3. Explain the coal formation process.

Course Outcome 2 (CO2):

1. Explain solar thermal power generation
2. Different nuclear reactors
3. Explain the problems associated with nuclear energy.

Course Outcome 3(CO3):

1. Outline borate hydroelectric power generation.
2. Explain the different wind mills and their components.
3. Write the advantages and disadvantages of thermal power plants

Course Outcome 4 (CO4):

1. Explain the types of biogas plants and design aspects.
2. Explain fuel cells and the different types with relevant diagrams.
3. Explain the energy conservation methodologies in chemical process plants.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:___________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SVENTH/EIGHTH SEMESTER B. TECH DEGREE EXAMINATION ________ ___ 20__

Course Code: BTT 413

Course Name: Energy Engineering

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.	
1.		What is a Flat Plate Collector?	
2.		Explain how is energy recovered from ocean tidal waves	
3.		Outline the anaerobic process for production of Biogas.	
4.		Explain the principle of a solar pond	
5.		Comment on Petroleum Coke? Give its uses.	
6.		Explain the radiation measuring instruments.	
7.		Outline the economics of wind farm.	
8.		Explain the basic aspects of nuclear radiation.	
9.		Give notes on co-generation in process industries.	
10.		What is the principle of Magneto Hydro Dynamics?	

PART B

Answer any one full question from each module. Each full question carries 14 marks.

11.	a)	How are Indian Coals classified as per IS-770? Briefly describe the characteristics and uses of each class.	7
	b)	Explain briquetting?	7
		OR	
12.	a)	Explain the different classification of energy	8
	b)	Give notes on the renewable sources of energy	6
13.	a)	Explain the working of a Solar water heating system giving a neat sketch.	5
	b)	How is solar energy converted into Electrical energy?	9
		OR	
14.	a)	Explain the working of BWR reactor.	8
	b)	Explain problems of nuclear power generations and what are the remedial measures adopted?	6
15.	a)	What are the merits and limitations of wind energy?	7
	b)	Explain the working of a hydroelectric Power Plant with a neat sketch.	7
		OR	
16.	a)	Give notes on different types of wind rotors with suitable diagrams.	8

	b)	Explain the disadvantages of hydrothermal energy.	6
17.	a)	What are fuel cells? Explain the working of a Hydrogen Fuel Cell.	8
	b)	Explain the energy conversion in petrochemical industries	6
		OR	
18.	a)	Discuss the significance of Biogas Plants as an alternative energy source.	7
	b)	Explain the design aspects of a biogas digester.	7
19.	a)	What are the energy conservation opportunities in a Chemical Process Plant?	8
	b)	Explain the environmental aspects of energy usage.	6
		OR	
20.	a)	Explain the energy conservation in petroleum industry.	6
	b)	What is Energy Audit? What are the steps involved in an Energy Audit?	8
		****	

Syllabus

Module 1: Classification and sources of energy; problems relating demand and supply of various energy sources. Energy, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy Crisis, energy alternatives. Energy conservation – Process modifications – Preventing energy loss - Waste utilisation – Energy audit.

Coal: origin and formation, composition and classification, resources and production, exploration and mining; analysis and testing storage and handling; coal carbonisation, briquetting, coal hydrogenation.

Module 2: Nuclear energy : basic aspects of nuclear radiation, fission and fusion, process reactor systems; BW/PW/HW reactor; gas cooled reactors, fast breeder reactor; thermal design; problems of nuclear power generations and remedial measures.

Solar energy : Facts and scope; solar radiation; radiation measuring instruments; basic flat collector; solar heat pump and heat engine cooling and refrigeration; solar pond; conversion of solar energy into electrical energy; solar thermal power generation.

Module 3: Hydroelectric energy; problems of hydro-electric energy and remedial measures. Thermal power plants, generation cycles, energy from ocean tidal wave, ocean thermal source; geothermal energy; wet steam and water, hot dry rocks, electricity from exothermal; sources.

Wind energy; tunnel mills and conversion cycles. Types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, economics of wind farm generation, wind power in India.

Module 4: Biogas plant and its design: KVIC plants, process kinetics, digester design, sludge treatment, energy from wastes. Development in energy routes. Conversion of heat to power: thermoelectric converters; thermo-electric refrigerators magneto-hydrodynamics.
Fuel cells; conversion of chemical energy into electricity, fuel cell performance; co-generation, efficiency improvement; energy conversion in petrochemical industries, polymer industries, natural organic industries, fertilizer industries etc.

Module 5: Energy conservation in chemical process plants, energy audit energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation in petroleum, fertilizer and steel industry, cogeneration, pinch technology, recycling for energy saving, electrical energy conservation in chemical Process plants, environmental aspects of energy use.

Text Books

1. S.B Pandya, "Conventional Energy Technology - Fuels and chemical Energy - TMH (1987).
2. S.P. Sharma and Chander Mohan, Fuels and Combustion, "TMH, 1984
3. Kash Kori, C., Energy resources, demand and conservation with special reference to India, TMH, 1975.
4. Rao S. & Parulekar B.B., Energy Technology, Khanna Publishers.
5. Bansal N.K., Kleeman M. & Meliss M., Renewable Energy Sources & Conversion, Tech., Tata McGraw Hill.
6. Goldmberg J., Johansson, Reddy A.K.N. & Williams R.H., Energy for a Sustainable World, John Wiley.

Reference Books

1. Gulp Jr., "Principles of Energy Conservation, "MGK (1979)
2. Chemtech I - Manual of Chemical Technology, "Vol.I. S. Chand and Co., New Delhi (1985).
3. Pride O.R., "Non-Conventional energy resources" JW (1983).
4. Connolly, T.J., "Foundation of nuclear engineering" JW (1978).
5. Gray T.J. and Gashos G.K., Tidel Power," Plenum Press (1972).
6. Sarkar S. "Fuels and Combustion, "Orient Longmans (1974).
7. Duffie T.R. and Beckman, W.A., 'Solar Energy Thermal Processes "JW (1974).
8. Sukhatme S.P., Solar Energy, Tata McGraw Hill.

9. Mittal K.M., Non-Conventional Energy Systems, Wheeler Publications.
10. Venkataswarlu D.I, Chemical Technology, S. Chand.
11. Pandey G.N., A Text Book on Energy System and Engineering, Vikas Publishing.
12. Rai G.D., Non-Conventional Energy Sources, Khanna Publishers.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
	Module 1	
1.1	Classification and sources of energy; problems relating demand and supply of various energy sources.	1
1.2	Energy, general classification of energy, world energy resources and energy consumption	1
1.3	Indian energy resources and energy consumption, energy Crisis, energy alternatives.	1
1.4	Energy conservation – Process modifications – Preventing energy loss - Waste utilisation – Energy audit.	1
1.5	Coal : origin and formation, composition and classification, resources and production, exploration and mining	1
1.6	Coal analysis and testing storage and handling; coal carbonisation, briquetting, coal hydrogenation.	2
	Module 2	
2.1	Nuclear energy : basic aspects of nuclear radiation, fission and fusion, process reactor systems .	1
2.2	BW/PW/HW reactor; gas cooled reactors, fast breeder reactor;	2
2.3	Thermal design; problems of nuclear power generations and remedial measures.	1
2.4	Solar energy: Facts and scope; solar radiation.	1
2.5	Radiation measuring instruments; basic flat collector; solar heat pump and heat engine cooling and refrigeration.	1
2.6	Solar pond; conversion of solar energy into electrical energy.	1
2.7	Solar thermal power generation.	1
	Module 3	
3.1	Hydroelectric energy; problems of hydro-electric energy and remedial measures.	1

3.2	Thermal power plants, generation cycles, energy from ocean tidal wave, ocean thermal source; geothermal energy; wet steam and water, hot dry rocks, electricity from exothermal; sources.	2
3.3	Wind energy; tunnel mills and conversion cycles. types of windmills,.	1
3.4	Types of wind rotors, Darrieus rotor and Gravian rotor .Wind electric power generation.	1
3.5	Wind power in India, economics of wind farm.	1
	Module 4	
4.1	Biogas plant and its design: KVIC plants, process kinetics, digester design, sludge treatment, energy from wastes.	2
4.2	Development in energy routes. Conversion of heat to power: thermoelectric converters; thermo-electric refrigerators magneto-hydrodynamics.	2
4.3	Fuel cells; conversion of chemical energy into electricity, fuel cell performance; co-generation, efficiency improvement.	2
4.4	Energy conversion in petrochemical industries, polymer industries.	1
4.5	Natural organic industries, fertilizer industries etc.	1
	Module 5	
5.1	Energy conservation in chemical process plants, energy audit energy saving in heat exchangers,	1
5.2	Energy audit energy saving in distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants.	2
5.3	Energy conservation in petroleum, fertilizer and steel industry, cogeneration, pinch technology	2
5.4	Recycling for energy saving, environmental aspects of energy use	1
	Total lecture hours	**35**

BTT423	GENETIC ENGINEERING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Study the application of gene, cell and tissue manipulations through molecular techniques in biotechnology.

Prerequisite: Basic understanding of undergraduate level courses such as biochemistry, microbiology and molecular biology.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Demonstrate different tools in genetic engineering and strategic approaches for cloning and expression of DNA molecules
CO2	Illustrate the design and constitution of DNA Cloning Vectors and methodologies involved
CO3	Apply the principles of various molecular mechanisms for the genomic and proteomic analysis
CO4	Evaluate the implementation of genetic engineering principles in gene sequencing, silencing, editing, recombinant protein production and transgenics.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				3		1					
CO2	2	3			1		2					
CO3	2	2	2		2	2	2					
CO4	2	3			3	3	3	2				

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course level assessment questions

Course Outcome 1(CO1): Demonstrate different tools in genetic engineering and strategic approaches for cloning and expression of DNA molecules

1. How is Klenow fragment produced? What are its applications?
2. Name and explain any 4 DNA modifying enzymes.
3. With the help of a diagram, explain Southern blotting.

Course Outcome 2 (CO2): Illustrate the design and constitution of DNA Cloning Vectors and methodologies involved

1. What are the salient features of a vector? Draw the vector map of pUC18 and explain different parts.
2. How will you construct cDNA libraries? How it differs from genomic DNA library?
3. What are the methods used for protein-protein interaction studies? Elaborate any one method.

Course Outcome 3 (CO3): Apply the principles of various molecular mechanisms for the genomic and proteomic analysis

1. Briefly describe any two types of PCRs in which more than two primers are used.
2. Illustrate the technological advancements in the evolution of DNA sequencing methodologies.
3. DNaseI Footprinting is used for the study of DNA-Protein interaction. Justify the statement.

Course Outcome 4 (CO4): Evaluate the implementation of genetic engineering principles in gene sequencing, silencing, editing, recombinant protein production and transgenics.

1. What are the problems with the production of insulin using bacterial expression systems? How these problems are being addressed?
2. You need to produce siRNA for silencing a specific gene. How many methods are available for this process? Elaborate any two methods with suitable diagram.
3. Elucidate Targeted Genome Editing by CRISPR/Cas9 technology.

Model Question Paper

			Total Pages:
RegNo.:_______________		Name:_________________________	
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SEMESTER B. TECH DEGREE EXAMINATION__________20__			
Course Code: BTT423			
Course Name: GENETIC ENGINEERING			
Max. Marks: 100		Duration: 3 Hours	

		PART A	
		Answer all questions, each carries 3 marks.	
1.		Explain the nomenclature scheme for restriction endonuclease enzyme with a suitable example.	
2.		If you want to detect a specific sequence in a mammalian genome by hybridization process without extracting the DNA, which method will you follow and why?	
3.		Write on Insertion and Replacement Lambda vectors with suitable examples.	
4.		Demonstrate the use of Phage display method for the selection of engineered proteins by exploring the intermolecular interactions.	
5.		How Hot start PCR differs from normal PCR? Describe any two methods by which you can achieve a hot start in a PCR reaction.	
6.		Explain Next generation DNA sequencing.	
7.		Differentiate between *in vivo* and *ex-vivo* approaches in Gene therapy.	
8.		Briefly describe the process of gene silencing using RNA interference technology	
9.		Describe the biosafety regulations in genetic engineering.	
10.		What is International HapMap project?	
		PART B	
		Answer any one full question from each module. Each carries 14 marks.	
11	a	How will you produce Klenow enzyme from DNA Polymerase enzyme? Mention any two applications of Klenow enzyme.	(4)
	b	Elaborate different ligation strategies employed for the successful cloning of DNA fragments.	(10)
		OR	
12	a	How will you label the probes for conducting Southern hybridization for detecting a specific DNA sequence in a genome? Explain all the methods with suitable diagram.	(14)

13	a	Illustrate the Blue-white screening method for the selection of recombinant transformed colonies by α- complementation.	(14)
		OR	
14	a	Polyadenylation of RNA species is an important criterion for the production of cDNA species. Express your opinion about this statement.	(4)
	b	What are the salient features of a cloning vector? Draw the vector map of pBR322.	(10)
15	a	How will you analyse DNA – Protein interaction by Electromobility shift assay? Explain the reason for the occurrence of shift and super shift in EMSA gel.	(7)
	b	How the Polymerase chain reaction has revolutionized modern biotechnology in analyzing and comparing the genomes?	(7)
		OR	
16	a	How will you determine the sequence of DNA using Sanger's dideoxy chain termination method? What are the main modifications done to this method to design Automated DNA sequencing methodology?	(14)
17	a	Elaborate Targeted Genome Editing by CRISPR/Cas9 technology.	(9)
	b	How does gene therapy approaches help us in tackling the health problems resulting from gene defects?	(5)
		OR	
18	a	You need to produce siRNA for silencing a specific gene. How many methods are available for this process? Elaborate any two methods with suitable diagram.	(14)
19	a	What are GM Plants? Describe the production of an insect resistant plant.	(14)
		OR	
20	a	Explain the production of Hepatitis B recombinant vaccine.	(10)
	b	What is the importance of HAT medium in hybridoma technology?	(4)

SYLLABUS

MODULE 1 Basic tools in Genetic engineering

Tools in Genetic Engineering: Restriction Enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Reverse transcriptase.

Ligation Strategies: Cohesive and blunt end ligation, Linkers, Adaptors, Homopolymeric tailing.

Labeling of DNA: Nick translation, Random primer labeling, End labeling, Radioactive and nonradioactive probes.

Hybridization techniques: Southern and Northern hybridization, Dot blot, Colon hybridization, Fluorescence *in situ* hybridization, Western Blotting.

MODULE 2: Vectors and methodologies in DNA Cloning

Cloning Vectors: Types of Cloning Vectors (structure and general features of General Purpose cloning vectors, Expression vectors, Promotor probe Vectors, shuttle vectors), Examples of cloning vectors (pBR322, pUC series of vectors, λ insertional and replacement vectors), derivatives of phages and plasmids (cosmids, phagemids, phasmids) cloning vectors for large DNA fragments (YACs, PACs and BACs).

Expression vectors: pET based vectors. **Protein tags:** His-tag and GST-tag.

Cloning Methodologies: Insertion of Foreign DNA into Host Cells, Transformation, Construction of libraries, Isolation of mRNA and total RNA, cDNA and genomic libraries, Expression cloning, Protein-protein interactive cloning and Yeast two hybrid system, Phage display.

MODULE 3: Molecular analysis of genome and proteome

Principle and procedure of PCR Types of PCR- (Real time PCR, hot start PCR, colony PCR, nested PCR, multiplex PCR, Touchdown PCR). Cloning of PCR products by T-vectors, Applications of PCR.

DNA-Protein Interactions: Chromatin Immunoprecipitation, Electromobility shift assay, DNAaseI footprinting, Methyl interference assay.

Mutation detection: SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test).

DNA sequencing- Chemical, enzymatic, pyrosequencing, next generation sequencing

MODULE 4: Genetic engineering techniques in gene manipulation

Gene silencing techniques: Introduction to siRNA, siRNA technology, Micro RNA, Construction of siRNA vectors, Principle and application of gene silencing.

Gene Therapy: Somatic and germ-line therapy- *in vivo* and *ex-vivo*, Gene replacement

Genome editing: CRISPR/Cas9 and Targeted Genome Editing

MODULE 5: Applications of Genetic engineering

Production of recombinant proteins: Production of recombinant proteins (Insulin), recombinant vaccines (Hepatitis B), Hormones (Human growth hormone), Immunoglobulins (Monoclonal antibodies).

Transgenics: Biopharming, Transgenic animals - transgenic mouse, transgenic fish. Transgenic plants- Engineered Nutritional Changes (Golden rice), Engineered herbicide resistance (Glyphosate-resistant crops), Engineered insect resistance (*Bt* Cotton). Advantages and disadvantages of Genetically Modified Organisms

Genome projects and its Applications: Human Genome Project, Rice genome project, International HapMap project.

Bioethics and safety: IPR related to rDNA technology, GAEC, Biosafety regulations in genetic engineering

Text Books

1) Smita Rastogi, Neelam Pathak, *Genetic Engineering*, Oxford University Press, Edition I, 2009.
2) E. L. Winnacker, From Genes to Clones Introduction to Gene Technology, New Delhi, India: Panima Publishing Corporation, 2003.
3) T. A. Brown, Gene Cloning and DNA Analysis-An Introduction. 5th ed. UK: Wiley Blackwell Publishers. 2006.

Reference Books

1) Primrose S B, Twyman R M, Old R W, *Principles of Gene Manipulation*, 6/e, Blackwell Science Limited, 2001.
2) Sambrook J, Russel D W, *Molecular Cloning: A Laboratory Manual,* Cold Spring Harbour Laboratory Press, 2012.
3) Desmond ST, Nicholl, *Introduction to Genetic Engineering,* Cambridge University Press, 2004.

4) Joshi P., *Genetic Engineering and its applications,* Agrobios, India, 2004.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Basic tools in Genetic engineering**	
1.1	**Tools in Genetic Engineering:** Restriction Enzymes, DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase, Reverse transcriptase.	2
1.2	**Ligation Strategies:** Cohesive and blunt end ligation, Linkers, Adaptors, Homopolymeric tailing.	2
1.3	**Labeling of DNA:** Nick translation, Random primer labeling, End labeling, Radioactive and nonradioactive probes.	2
1.4	**Hybridization techniques:** Southern and Northern hybridization, Dot blot, Colon hybridization, Fluorescence *in situ* hybridization, Western Blotting..	2
2	**Vectors and methodologies in DNA Cloning**	
2.1	**Cloning Vectors:** Types of Cloning Vectors (structure and general features of General Purpose cloning vectors, Expression vectors, shuttle vectors), Examples of cloning vectors (pBR322, pUC series of vectors, λ insertional and replacement vectors),	2
2.2	Derivatives of phages and plasmids (cosmids, phagemids, phasmids) cloning vectors for large DNA fragments (YACs, PACs and BACs).	2
2.3	**Expression vectors**: pET based vectors. **Protein tags:** His-tag and GST-tag.	1
2.4	**Cloning Methodologies:** Insertion of Foreign DNA into Host Cells, Transformation, Construction of libraries, Isolation of mRNA and total RNA, cDNA and genomic libraries,	2
2.5	Expression cloning, Protein-protein interactive cloning and Yeast two hybrid system, Phage display.	1
3	**Molecular analysis of genome and proteome**	
3.1	**Principle and procedure of PCR** Types of PCR- (Real time PCR, hot start PCR, colony PCR, nested PCR, multiplex PCR, Touchdown PCR). Cloning of PCR products by T-vectors, Applications of PCR.	2
3.2	**DNA-Protein Interactions**: Chromatin Immunoprecipitation, Electromobility shift assay, DNAaseI footprinting, Methyl interference assay.	2
3.3	**Mutation detection:** SSCP, DGGE, RFLP, Oligo Ligation Assay (OLA), MCC (Mismatch Chemical Cleavage, ASA (Allele-Specific Amplification), PTT (Protein Truncation Test).	2
3.4	**DNA sequencing-** Chemical, Enzymatic, Pyrosequencing, Next	2

	generation sequencing	
4	**Genetic engineering techniques in gene manipulation**	
4.1	**Gene silencing techniques:** Introduction to siRNA, siRNA technology, Micro RNA, Construction of siRNA vectors, Principle and application of gene silencing.	2
4.2	**Gene Therapy:** Somatic and germ-line therapy- *in vivo* and *ex-vivo*, Gene replacement	1
4.3	**Genome editing:** CRISPR/Cas9 and Targeted Genome Editing	1
5	**Applications of Genetic engineering**	
5.1	**Production of recombinant proteins**: Production of recombinant proteins (Insulin), recombinant vaccines (Hepatitis B), Hormones (Human growth hormone), Immunoglobulins (Monoclonal antibodies).	2
5.2	**Transgenics:** Biopharming, Transgenic animals - transgenic mouse, transgenic fish. Transgenic plants- Engineered Nutritional Changes (Golden rice), Engineered herbicide resistance (Glyphosate-resistant crops), Engineered insect resistance (*Bt* Cotton). Advantages and disadvantages of Genetically Modified Organisms	2
5.3	**Genome projects and its Applications:** Human Genome Project, Rice genome project, International HapMap project.	2
5.4	**Bioethics and safety:** IPR related to rDNA technology, GAEC, Biosafety regulations in genetic engineering	1
	Total lecture hours	**35**

BTT 433	PROTEOMICS AND PROTEIN ENGINEERING	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Familiarise the concept of proteome and its applications in any applied area of biosciences.

Prerequisite: Knowledge about protein and its structure.

Course Outcomes: After the completion of the course the student will be able to

CO1	Describe the concept proteome and various interactions in protein makeup.
CO2	Describe the techniques involved in protein separation and purification.
CO3	Explain the methods for detection of proteins.
CO4	Explain the advanced applications of proteomics.
CO5	Explain the basic concept of design of a new protein molecule.

Mapping of course outcomes with program outcomes:

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				2							
CO2					3	2						2
CO3	3	2	2		3							2
CO4	2					2	2	2				
CO5	3	3	3			3	3	3				2

Mark distribution:

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 subdivisions and carry 14 marks.

Course Level Assessment Questions:

Course Outcome 1 (CO1):

1. State the concept of proteome, protein structure and functional protein families.
2. Outline the role of proteomics in various fields.
3. Describe the various interactions in protein makeup.

Course Outcome 2 (CO2):

1. Illustrate the mechanism behind various chromatography and electrophoresis techniques for protein separation and purification.

Course Outcome 3 (CO3):

1. List out the various techniques used for the detection of proteins.
2. Detail the mechanism behind each method of protein detection.

Course Outcome 4 (CO4):

1. Narrate the role of functional proteomics in protein chip techniques.
2. Narrate the role of proteomics in advanced applications.

Course Outcome 5 (CO5):

1. Discuss the importance of protein engineering.
2. Illustrate the basic concepts of design of a new protein molecule.

Model Question Paper

		Total Pages:
Reg No.:		Name:
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY _________SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
COURSE CODE: BTT433		
COURSE NAME: PROTEOMICS AND PROTEIN ENGINEERING		
Duration: 3 hrs		Maximum marks: 100
PART A		
Answer all questions, each carries 3 marks.		

1.	a	Define the term proteome.	(3)
2.	b	Chaperons plays important roles in protein folding. How ?	(3)
3.	c	Give the principle of affinity chromatography.	(3)
4.	d	Explain the terms resolution and reproducibility of Two dimensional electrophoresis.	(3)
5.	e	Give the principle of 2D PAGE	(3)
6.	f	Define peptide fingerprinting.	(3)
7.	g	List out the different types of protein chips	(3)
8.	h	Comment on the role of proteins in drug development.	(3)
9.	i	Explain the basic principle of protein engineering.	(3)
10.	j	What are engineered proteins?	(3)
		PART B	
Answer any one full question from each module. Each carries 14 marks.			
11.	a	Discuss in detail on the role of different non covalent interactions in protein structure and function.	6
	b	Discuss the challenges present in the study of proteomics.	8
		Or	
12.		Discuss in detail of protein folding with suitable examples.	14
13.		Explain in detail any two charge based techniques used for the protein separation.	14
		Or	
14.		Expand and explain the following IEF and SDS -PAGE.	14
15.		Give the principle and function of MALDI MS , also comment on its importance in the study of proteins.	14
		Or	
16.		Proteins separated by gel electrophoresis can be visualized using different staining procedures. Explain different types of dyes used for this purpose.	14
17.	a	Discuss the protein chip technology with its limitations.	7
	b	Explain on any two detection methods for proteins bound to chips.	7
		Or	

18.	a	Give the significance of mining of proteome. Explain any one method in detail.	8
	b	Write the importance of proteomics in drug development and toxicology.	6
19.	a	Give the steps for Protein engineering	5
	b	Explain the engineering of Subtilisin.	9
		Or	
20.		Explain the importance of enzyme engineering with an example.	14

Syllabus:

Introduction to the concept of proteome, Protein folding, Protein separation techniques, Detection of proteins and Image analysis, Enhancing high-throughput proteome analysis, Functional proteomics, Application of Proteomics and Protein engineering.

Module 1:

Introduction to the concept of proteome, protein structure, functional protein families, importance of proteomics in biological functions, scope of proteomics, challenges of proteomics.
Protein folding: Hierarchical protein folding, Molecular chaperones, role of chaperones in protein folding, Defective protein folding; Proteasomes, Prions, Polyketides and non-ribosomal peptides- Combinational manipulation of polyketides and non-ribosomal peptides.

Module 2:

Protein separation techniques: Ion-exchange, size-exclusion and affinity chromatography techniques; Polyacrylamide gel electrophoresis; *Isoelectric focusing (IEF)*, IPG, Two-dimensional PAGE for proteome analysis, Equilibration between dimensions- The second dimension: SDS-PAGE-resolution and reproducibility of 2-Dimensional Electrophoresis.

Module 3:

Detection of proteins in polyacrylamide gels and on electroblot membranes: Use of Organic dyes and silver stains, Reverse stains, Colloidal dispersion stains, organic fluorophore stains, metal chelate stains. Impact of stable isotope labeling – introduction, Sample preparation, two-dimensional gel separation and image analysis of two-dimensional gels: Data acquisition, digital image processing, Protein spot detection and quantitation, Gel matching, Data analysis, data presentation, protein data bases. Peptide fingerprinting, Mass spectrometry: MALDI-MS, protein identification using MS/MS data.

Module 4:

Functional proteomics: Protein array, protein chips - introduction, different types of protein chips, detection and quantification of proteins bound to protein chips, emerging protein chip technologies.
Application of Proteomics: Mining proteomes, protein expression profile, identification of protein-protein interactions and protein complexes, drug development and toxicology.

Module 5:

Protein engineering: Protein engineering- basic principles, strategies, basic concepts of design of a new protein molecule, specific example of enzyme engineering (Subtilisin, Peroxidase), Case studies.

Text Books:

1. Pennington SR, Dunn MJ, *Proteomics*: *From Protein Sequence to Function,* Viva Books, 2001.
2. Daniel C Liebler, *Introduction to Proteomics,* Humana Press, 2001.

Reference books:

1. Twyman RM, *Principles of Proteomics*, BIOS Scientific Publishers, 2004.
2. Sahai S, *Genomics and Proteomics-functional and computational aspects,* Plenum publications, 1999.
3. Moody PCE, Wilkinson AJ, *Protein Engineering*, IRL press, Oxford, 1990.

Course contents and Lecture schedule

No.	Syllabus	No. of Lectures
1.1	**Introduction** to the concept of proteome, protein structure, functional protein families, importance of proteomics in biological functions, scope of proteomics, challenges of proteomics.	3
1.2	**Protein folding**: Hierarchical protein folding, Molecular chaperones, role of chaperones in protein folding, Defective protein folding; Proteasomes, Prions, Polyketides and non- ribosomal peptides- Combinational manipulation of polyketides and non-ribosomal peptides.	4
2.1	**Protein separation techniques**: ion-exchange, size-exclusion and affinity chromatography techniques.	3
2.2	Polyacrylamide gel electrophoresis; *Isoelectric focusing (IEF)*, IPG, Two-dimensional PAGE for proteome analysis, Equilibration between dimensions- The second dimension: SDS-PAGE-resolution and reproducibility of 2-Dimensional Electrophoresis.	4
3.1	**Detection of proteins** in polyacrylamide gels and on electroblot membranes: Use of Organic dyes and silver stains, Reverse stains, Colloidal dispersion stains, organic fluorophore stains, metal chelate stains.	3
3.2	Impact of stable isotope labelling – introduction, Sample preparation, two-dimensional gel separation and image analysis of two-dimensional gels: Data acquisition, digital image processing, Protein spot detection and quantitation, Gel matching, Data analysis, data presentation, protein data bases.	4
3.3	Peptide fingerprinting, Mass spectrometry: MALDI-MS, protein identification using MS/MS data.	2
4.1	**Functional proteomics**: Protein array, protein chips - introduction, different types of protein chips, detection and quantification of proteins bound to protein chips, emerging protein chip technologies.	3
4.2	**Application of Proteomics**: Mining proteomes, protein expression profile, identification of protein-protein interactions and protein complexes, drug	3

	development and toxicology.	
5.1	**Protein engineering:** Protein engineering- basic principles, strategies, basic concepts of design of a new protein molecule, specific example of enzyme engineering (Subtilisin, Peroxidase), Case studies.	7

BTT 443	BIO NANOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Articulate applications of nanomaterials in the various fields of Biotechnology

Prerequisite: Basics of chemistry and biology

Course Objectives:
To understand the basics of Nano biotechnology and its applications

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the production of various types of nanostructured materials
CO 2	Evaluate the applications of various types of Nano materials in biotechnology
CO 3	Understand the organization of the naturally occurring nanomaterials
CO 4	Describe ethical and socioeconomic challenges of nanomaterials

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	2	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-
CO3	2	2	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Evaluate the production and applications of various types of Nano materials

1. Illustrate the properties of nano materials that support the application diagnosis
2. Cite examples of applications of nano materials in therapy
3. Evaluate the advantages of chemical methods of synthesis of nano materials

Course Outcome 2 (CO2): Understand the organization of the naturally occurring nano materials

1. Explain self-assembly of DNA and its relevance for its function.
2. Elaborate on the protein based nano structures.
3. What is the significance of nano printing of DNA in diagnosis

Course Outcome 3 (CO3): Understand the organization of the naturally occurring nano materials

1. Explain self-assembly of DNA and its relevance for its function.
2. Elaborate on the protein based nano structures.
3. What is the significance of nano printing of DNA in diagnosis

Course Outcome 4 (CO4): Describe ethical and socioeconomic challenges of nanomaterials

1. What are the ethical concerns in the application of nano materials?
2. Elaborate on the biological and environmental toxicity of nano materials
3. How is the life cycle assessment of nanomaterials performed?

Model Question paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 443

Course Name: BIO NANOTECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1.		Elaborate on any two physical methods for the synthesis of nano materials.
2.		Justify SEM and TEM as an effective tool for the characterisation of nano materials.
3.		Write any three properties of nano materials that facilitate their application in imaging?
4.		Enumerate the applications of nanomaterials in tissue engineering.
5.		What are the distinguishing features of nanomotors in *E.coli*?
6.		Justify the role of nanoparticles in labelling of cells.
7.		What are the advantages of microbial nanoparticles?
8.		Enumerate the application of bacteriorhodopsin in energy.
9.		Write notes on legal issues of the application of nanoparticles.
10.		What are the environmental toxic effects of nanoparticles?

PART B

Answer any one full question from each module. Each carries 14 marks.

11.		Elaborate on the chemical methods for the synthesis of nano materials	(14)
		OR	
12.		Explain the methods for used the characterisation of nano materials synthesized.	(14)
13.		Discuss the applications of nano materials in drug discovery and drug delivery.	(14)
		OR	
14.		Nano materials have a wide range of applications in analytical techniques. Justify	(14)

15.		Describe the science of nanoparticle functionalization and their applications.	(14)
		OR	
16.		Illustrate the applications of Biochips in nanoscale detection.	(14)
17.		Explain the various methods of microbial nanoparticle production.	(14)
		OR	
18.		Elaborate on the bacteriorhodopsin and its potential in technical applications	(14)
19.		Elaborate on the ethical and societal issues in Nano biotechnology	(14)
		OR	
20.		Explain how the toxicity assessment of nano particles is performed and what are the modifications of nanomaterials that can be made to make them eco-friendly?	(14)
		****	

Syllabus

Module 1: Introduction to Nano biotechnology

Nano biotechnology- introduction. Development of Nano biotechnology - timelines and progress, prospects and challenges. Nano scale structures and materials (Carbon nanotubes, Fullerenes, Quantum dots, Metal nanoparticles, Lipid based nanostructures, Polymeric nanoparticles), basic principles underlying the fabrication of these nano materials, brief introduction to structure and physical and chemical characterisation of Nano materials.

Module 2: Applications of nano materials

Applications - medical and diagnostics, environment, food, bioseparation, drug discovery and delivery, nanotechnology for tissue engineering: applications in regenerative therapy, analytical applications

Module 3: Protein based nanostructures

Protein-based nanostructures, Nano motors -bacterial (*E.coli*) and mammalian(Myosin family), nanoparticles in biological labeling and cellular imaging, science of nanoparticles functionalization, Nano printing of DNA, RNA, and proteins, Biochips applications in Nano scale detection, Lab-on-a-chip devices.

Module 4: Microbial nanoparticles

Microbial nanoparticles, biosynthesis of nanoparticles by microorganisms, methods of microbial nanoparticle production, applications of microbial nanoparticles, bacteriorhodopsin and its potential in technical applications-overview, structure, photoelectric applications, photochromic applications and applications in energy.

Module 5: Ethical and societal issues

Ethical and societal issues in Nano biotechnology, socioeconomic challenges, ethical issues with special reference to Nano medicine, legal issues, life-cycle assessment and risk assessment of Nano materials. Toxicity of Nano materials –biological toxicity and environmental toxicity, reasons for toxicity, toxicity assessment, modification of nanomaterials to make them ecofriendly

TEXT BOOKS

1. Chandran Karunakaran, Kalpana Bhargava, Robson Benjamin (Eds.), *Biosensors and Bioelectronics*, Elsevier, 2015.
2. David S Goodsell, *Bionanotechnology*, John Wiley & Sons, 2004.
3. Mark Wiesner, Jean-Yves Bottero, *Environmental Nanotechnology: Applications and Impacts of nanomaterials*, McGraw Hill, 2007.

REFERENCES:

1. Christof M Niemeyer, Chad A Mirkin (Eds.), *Nano biotechnology: Concepts, Applications and Perspectives*, Wiley VCH, 2004.
2. Tuan Vo-Dinh (Ed.), *Nanotechnology in Biology and Medicine: Methods, Devices, and Applications*, CRC Press, 2007.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Nano biotechnology**	
1.1	Nano biotechnology- introduction	1
1.2	Development of Nano biotechnology - timelines and progress, prospects and challenges	2
1.3	Types of nano scale structures and materials	1
1.4	Nano scale structures and materials (Carbon nanotubes, Fullerenes, Quantum dots, Metal nanoparticles, Lipid based nanostructures, Polymeric nanoparticles), basic principles underlying the fabrication of these nano materials	2
1.5	Physical and chemical characterisation of Nano materials	2
2	**Applications of nano materials**	
2.1	Applications - medical and diagnostics	2
2.2	Applications - environment, food, bioseparation,	2
2.3	Applications - nanotechnology for tissue engineering: applications in regenerative therapy	2
2.4	Applications - analytical applications	2
3	**Protein based nanostructures**	
3.1	Protein-based nanostructures - Introduction	1
3.2	Nano motors -bacterial (E.coli) and mammalian (Myosin family)	1

3.3	Nanoparticles in biological labeling and cellular imaging, science of nanoparticles functionalization	2
3.4	Nano printing of DNA, RNA, and proteins	2
3.5	Biochips applications in Nano scale detection, Lab-on-a-chip devices.	2
4	**Microbial nanoparticles**	
4.1	Microbial nanoparticles, biosynthesis of nanoparticles by microorganisms	1
4.2	Methods of microbial nanoparticle production	1
4.3	Applications of microbial nanoparticles,	1
4.4	Bacteriorhodopsin and its potential in technical applications-overview, structure, photoelectric applications, photochromic applications and applications in energy.	2
5	**Ethical and societal issues**	
5.1	Ethical and societal issues in Nano biotechnology, socioeconomic challenges, ethical issues with special reference to Nano medicine, legal issues,	2
5.2	Life-cycle assessment and risk assessment of Nano materials.	2
5.3	Toxicity of Nano materials –biological toxicity and environmental toxicity, reasons for toxicity, toxicity assessment, modification of nanomaterials to make them eco-friendly.	2
	Total lecture hours	**35**

BTT453	MODELING OF TRANSFER PROCESSES	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:
This course is aimed at providing an insight into the basic science underlying various transport phenomena in process engineering. The principles underlying the transport of momentum, heat and mass shall be thoroughly explicated, with appropriate mention of their applications in process engineering systems

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Classify Newtonian and Non-Newtonian fluids with suitable examples
CO2	Interpret the transport properties of gases and liquids
CO3	Solve steady state problems in momentum, heat and mass transfer through shell balance equations with suitable boundary conditions.
CO4	Examine the transport equations of momentum and heat for solve steady flow and heat transfer problems.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3											
CO3	3											
CO4	3	2										

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A contains 10 questions with 2 questions from e ach module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions:

Course Outcome 1 (CO1): Classify Newtonian and Non-Newtonian fluids with suitable examples

1. Different mathematical models are used to express the rheological behaviour of non-Newtonian fluids. Interpret the power law model and Bingham model for the above behaviour with examples of fluids.
2. Differentiate between Newtonian and Non- Newtonian fluids with suitable examples?
3. Explain the two parameter and three parameter Non-Newtonian fluid models and represent them graphically. Give any one example of fluids exhibiting such behaviour.

Course Outcome 2 (CO2): Interpret the transport properties of gases and liquids

1. Viscosity, thermal conductivity and mass diffusivity of fluids depend on temperature and pressure. Explain how this can be explained using the correlations using Principle of corresponding states.
2. How do you determine viscosity and mass diffusivity at different temperature and pressure?
3. Explain the effect of temperature and pressure on thermal conductivity?

Course Outcome 3 (CO3): Solve steady state problems in momentum, heat and mass transfer through shell balance equations with suitable boundary conditions.

1. A flat plate of area 1.5 x 106 mm^2 is pulled with the speed of 0.4 m/s relative to another plate located at a distance 0.15 mm apart from it. Find the force and power required to maintain the speed, if the fluid separating them having viscosity as 1 Pa.s.
2. A Newtonian fluid is in laminar flow in a narrow slit formed by two paralle1 walls at a distance 2B apart. It is assumed that the "edge effects" are unimportant. The flow is laminar and the fluid is incompressible of density ρ and the viscosity μ. Here the width of the slit 2B is very small compared to the length L and width W of the plate. Identify a suitable shell and obtain the expressions for the velocity distribution, maximum velocity, ratio of the average velocity to the maximum velocity and the flow rate.
3. Ammonia gas (A) and Nitrogen (B) are diffusing in counter diffusion through a straight glass tube 0.61 m long with an inside diameter of 24.4 mm at 298 K and 101.32 KPa. Both ends of the tube are connected to a large mixed chamber at 101.32 KPa. The partial pressure of ammonia is constant at 20 kPa in one chamber and 6.67 kPa in the other. The diffusivity of the system is 2.3 x10-5 under these conditions. Calculate the diffusion of ammonia in kmol/s.

Course Outcome 4 (CO4): Examine the transport equations of momentum and heat for solve steady flow and heat transfer problems.

1. Consider a Newtonian fluid flowing through a cylindrical pipe of radius R under the influence of gravity and pressure forces. Use the transport equations to set up the problem and hence obtain the velocity distribution of the fluid within the cylinder.
2. Use the equations of change to derive the velocity distribution for the flow of incompressible Newtonian fluid through a slit of cylindrical walls at a distance of 2B apart.
3. A stormer viscometer essentially consists of two cylinders in which the inner one rotates with an angular velocity Ω_i and outer is held stationary, the diameter of inner cylinder is kR and that of outer is R. Develop the expression for laminar flow of a Newtonian fluid. Also find out the torque on the inner cylinder.

Model Question Paper

			Total Pages:
Reg No.:_______________			Name:___________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, -------------------20----

Course Code: BTT453

Course Name: MODELING OF TRANSFER PROCESSES

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions. Each question carries 3 marks	Marks
1.		Discuss the significance of Lennard Jones parameters.	(3)
2.		Viscosity of liquids can be measured using coaxial cylinder rotary viscometer. Discuss the principle and relevant equations used in the measurement.	(3)
3.		Interpret the analogy between momentum, heat and mass transfer.	(3)
4.		Show that $J^A + J^B = C(V^*-V)$	(3)
5.		Sketch velocity and momentum flux distribution for the laminar flow of Newtonian fluid through a circular tube	(3)
6.		State the Navier-Stokes equation. What does each term represent?	(3)
7.		List out any three criteria used in the selection of the form and orientation of the volume element in shell heat balance?	(3)
8.		Describe the boundary conditions used in solving heat transfer problems?	(3)
9.		Illustrate the significance of diffusion velocity in mass transport operations?	(3)
10.		Define effectiveness factor and explain its significance	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11.	a	Explain the Eyring theory of thermal conductivity of liquids and derive an equation to show the temperature dependence of thermal conductivity of liquids	(8)
	b	List and explain any three factors affecting viscosity of fermentation broths.	(6)
12.	a	A gas mixture is composed of 23 % carbon dioxide, 14 % Oxygen and 63 % Nitrogen at 20 ^{0}C and 1 atm. Estimate the viscosity of the gas mixture. Use the viscosity data of the pure components from the above problem. The viscosities of pure Carbon dioxide, Oxygen and Nitrogen are respectively 1462×10^{-9}, 2031×10^{-9} and 1754×10^{-9} Centipoise.	(8)
	b	a) Explain the different mathematical models used to express the	(6)

		rheological behaviour of non-Newtonian fluids.	
Module 2			
13.	a	Explain how are the molar fluxes of a given species with respect to a stationary coordinate in a mixture consisting of several species is related to the molar flux of the same species with respect to a moving coordinate.	(5)
	b	Prove the following i) $j_A^* = n_A - x_A(n_A + \frac{M_A}{M_B} n_B)$ ii) $j_A = n_A - w_A(n_A + n_B)$ iii) $J_A^* + J_B^* = 0$	(9)
14.	a	The kinetic theory for diffusion in simple liquids is not as well developed as that for dilute gases, and it cannot presently give accurate analytical predictions of diffusivities. As a result the understanding of liquid diffusion depends primarily on the crude theories. Explain any two such theories and the associated models for diffusivity in liquids.	(9)
	b	Explain the Bridgeman theory of thermal conductivity of liquids	(5)
Module 3			
15.		Derive the expression for the velocity distribution in a Newtonian fluid falling under laminar flow as a film along the surface of a vertical wall and hence obtain expressions for the average velocity, maximum velocity, the force exerted on the walls and the film thickness.	
16.		An incompressible Newtonian fluid under the influence of pressure gradient flows through the annular region between two coaxial cylinders. Derive an expression for velocity and shear stress distribution. Also derive expressions for the average velocity, maximum velocity and flow rate.	
Module 4			
17.		An electrically heated copper wire has a radius of 4 mm and a length of 6 m. Determine the voltage drop required to maintain a temperature rise of 20 ^{0}C at the wire axis if the surface temperature of the wire is 30 ^{0}C. Also use a shell energy balance, formulate the differential equations and derive the expressions that you use to solve the problem. For copper, the Lorenz number at the surface temperature is given as 2.23 x 10^{-8} volt^2/K^2.	(14)
18.		Using a steady state shell energy balance, formulate the expression for the temperature distribution in a rectangular fin of suitable dimensions assuming that there is no heat transfer from the tip of the fin. Also obtain the expression for the fin efficiency.	(14)
Module 5			
19.		A gas A dissolves and diffuses in a liquid B kept in a container. During its dissolution, the gas undergoes a first order irreversible reaction to form	(14)

		another product C. Using suitable assumption, geometry and appropriate boundary conditions applicable to the problem, obtain the expression for the concentration profile and the average concentration of the gas A in the liquid. Further obtain the molar flux of the gas at the gas-liquid interface. Also sketch the concentration profile of gas A in the liquid.	
20.		A spherical liquid droplet A is evaporating into an isothermal film of gas B surrounding the liquid. Use a shell mass balance approach and appropriate boundary conditions; derive the concentration profile of A in the gas film and the molar flux of A at the gas-liquid interface. Write all the assumptions used.	(14)

Syllabus

Module 1:

Introduction to Momentum Transport:

Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity, molecular momentum transport, generalization of Newton's law of viscosity, pressure and temperature dependence of viscosity of gases and liquids, prediction of viscosity of gases: Rigid sphere model and rigorous models, prediction of transport coefficients of liquids. Numerical problems. Non- Newtonian fluids, different models for Non-Newtonian flow, theory of viscosity of gases, gas mixture and liquids.

Introduction to Heat Transport: Fourier's Law, Newton's Law of cooling, Energy Transport – Thermal conductivity and the mechanism of energy transport- prediction of thermal conductivity of gases, effect of temperature and pressure on thermal conductivity of gases, relationship between thermal conductivity and viscosity of gases. Thermal conductivity of solids. Relationship between thermal and electrical conductivity of solids, Numerical problems.

Module 2:

Introduction to Mass Transport:

Diffusivity and the Mechanism of Mass Transport: Definitions of various concentration terms, velocities, Mass and Molar fluxes-Notations and relationships for various Mass and molar fluxes. Analogies between Heat mass and Momentum Transfer, Fick's law of diffusion, Temperature and pressure dependency of diffusivity, kinetic theory of diffusion in gases at low density, theory of ordinary diffusion in binary liquids-Numerical Examples.

Prediction of diffusivity of gases and liquids. Numerical problems. Shell momentum balances and boundary conditions for momentum, heat and mass transport.

Module 3:

Velocity distribution in laminar flow: Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions, flow of a falling film along a flat surface, flow of a Newtonian fluid in between two slits formed by two flat plates, flow through a circular tube, flow through annulus

General transport equation for momentum - derivation of continuity equation, Analysis of equation of motion in rectangular coordinates (derivation not desired), Navier Stoke's equation and Euler equation with significance of each terms, transport equation in curvilinear coordinates (derivation not desired)

Application of transport equations to solve steady flow problems:- flow through a tube, tangential annular flow, rotating liquid

Module 4:

Application of shell balances to heat conduction problems:- With electric, nuclear & viscous heat sources-cooling fins with insulated tip condition.

Equations of energy:- energy equation in rectangular coordinates-energy equations in curvilinear coordinates (derivation not desired)

Application of transport equations to solve steady heat transfer problems:- tangential flow in annulus with viscous heat generation- free convection from vertical plate.

Module 5:

Shell mass balances: diffusion through a stagnant gas film- diffusion with heterogeneous chemical reaction(for slow and instantaneous reactions)- diffusion with homogeneous chemical reaction- diffusion through a spherical stagnant gas film surrounding a droplet of liquid- diffusion and chemical reaction inside a porous catalyst: the effectiveness factor- General study equation of continuity for binary mixtures in rectangular coordinates (derivation not desired)-equation of continuity in curvilinear coordinates (derivation not desired).

Text Books

1. Bird R B, Stewart W E and Lightfoot R N, Transport Phenomena, John Wiley and Sons.
2. John C Slattery, Momentum, Energy and Mass transfer in continua, McGraw Hill, Co.
3. Bennet C U and Myers J E, Momentum, Heat and Mass Transfer, Tata McGraw Hill Publishing Co.

Note: The students may be permitted to use attested copies of tables of general equations of continuity, motion and energy in Cartesian, rectangular and curvilinear coordinates, and Fluid Properties Tables inside the examination hall.

Reference Books

1. Robert S. Brodkey and Harry C Hersing, Transport Phenomena a Unified Approach, McGraw Hill.
2. Atkinson B and Mavituna F, Biochemical Engineering and Biotechnology, Handbook, Macmillan

Course Contents and Lecture Schedule

No	Topic	No of lectures
1.1	Introduction to Momentum Transport, Viscosity and the mechanisms of momentum transfer: Newton's law of viscosity, molecular momentum transport, generalization of Newton's law of viscosity	1
1.2	Pressure and temperature dependence of viscosity of gases and liquids, prediction of viscosity of gases: Rigid sphere model and rigorous models, prediction of transport coefficients of liquids. Numerical problems.	1
1.3	Non- Newtonian fluids, different models for Non-Newtonian flow.	1
1.4	Theory of viscosity of gases, gas mixture and liquids	1
1.5	Numerical problems.	1
1.6	**Introduction to Heat Transport**: Fourier's Law – Newton's Law of cooling, Energy Transport: Thermal conductivity and the mechanism of energy transport- prediction of thermal conductivity of gases	2
1.7	Effect of temperature and pressure on thermal conductivity of gases, relationship between thermal conductivity and viscosity of gases. Thermal conductivity of solids, relationship between thermal and electrical conductivity of solids	2
1.8	Numerical problems. Shell energy balance:- Boundary conditions	1
2.1	Diffusivity and the Mechanism of Mass Transport: Definitions of various concentration terms, velocities, Mass and Molar fluxes-Notations and relationships for various Mass and molar fluxes	1
2.2	Analogies between Heat mass and Momentum Transfer, Fick's law of diffusion	1
2.3	Temperature and pressure dependency of diffusivity, kinetic theory of diffusion in gases at low density, theory of ordinary diffusion in binary liquids-Numerical Examples.	2
2.4	**Prediction of diffusivity of gases and liquids**. Numerical problems.	2
2.5	Shell momentum balances and boundary conditions for momentum, heat and mass transport.	1
3.1	**Velocity distribution in laminar flow:** Shell momentum balances and velocity distributions in laminar flow: shell momentum balances and boundary conditions	1
3.2	Flow of falling film along a flat surface	1
3.3	Flow of a Newtonian fluid in between two slits formed by two flat plates, flow through a circular tube, flow through annulus	2
3.4	**General transport equation for momentum** - derivation of continuity equation, Analysis of equation of motion in rectangular coordinates	2

	(derivation not desired), Navier Stoke's equation and Euler equation with significance of each terms, transport equation in curvilinear coordinates (derivation not desired)	
3.5	**Application of transport equations to solve steady flow problems**:- flow through a tube, tangential annular flow, rotating liquid	2
4.1	**Application of shell balances to heat conduction problems:-** With electric, nuclear & viscous heat sources-cooling fins with insulated tip condition.	2
4.2	**Equations of energy:-** energy equation in rectangular coordinates-energy equations in curvilinear coordinates (derivation not desired)	1
4.3	**Application of transport equations to solve steady heat transfer problems:-** tangential flow in annulus with viscous heat generation- free convection from vertical plate.	2
5.1	**Shell mass balances:** diffusion through a stagnant gas film	1
5.2	Diffusion with heterogeneous chemical reaction(for slow and instantaneous reactions)-	1
5.3	Diffusion with homogeneous chemical reaction- diffusion through a spherical stagnant gas film surrounding a droplet of liquid	1
5.4	Diffusion and chemical reaction inside a porous catalyst: the effectiveness factor	1
5.5	General study equation of continuity for binary mixtures in rectangular coordinates (derivation not desired). Equation of continuity in curvilinear coordinates (derivation not desired)	1
	Total lecture hours	**35**

BTT463	APPLIED MICROBIAL TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:
Study in detail the Application of microorganisms in various human endeavors and environment

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the scope and importance of microorganisms in various fields.
CO 2	Elaborate the role of microorganisms in various eco sustainable processes.
CO 3	Analyze the use and applicability of microorganisms in emerging technologies.
CO 4	Summarize the potential use of microorganisms as restorative agents.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3			-				-	-	-	-	-
CO2	3				-		2	-	-	-	-	-
CO3	3				2			-	-	-	-	-
CO4	3				-		2	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	40	30	80
Apply		10	10
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the scope and importance of microorganisms in different fields.

1. Summarize the application of microorganisms in different fields
2. Compare the advantages and disadvantages of microbial technology in various industries.

Course Outcome 2 (CO2): Illustrate the role of microorganisms in various eco sustainable processes.

1. Interpret the role of microorganisms in lignocellulosic technology for sustainable development.
2. Classify the various bioleaching processes and role of microorgaanisms.

Course Outcome 3 (CO3): Analyze the use and applicability of microorganisms in emerging technologies.

1. Examine the role of microbial nanoparticles in water treatment process.
2. Develop a bioremediation technique using microbial biofilms.

Course outcome 4 (CO4): Summarize the potential use of microorganisms as restorative agents

1. Classify the applied microbial techniques used in the preservation of monuments.
2. Illustrate the role of microorganisms in rejuvenation of soil crusts.

Model Question Paper

			Total Pages:
Reg No.:________________		Name:____________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, -------------------20----

Course Code: BTT 463

Course Name: APPLIED MICROBIAL TECHNOLOGY

Max. Marks: 100	Duration: 3 Hours

PART A

	Answer all questions. Each question carries 3 marks	Marks
1.	Define the scope of applied microbial technology.	(3)
2.	Give the flow chart for the production of any one fermented dairy product.	(3)
3.	Outline the role of microorganisms in rejuvenation of barren soil.	(3)
4.	Define indirect bioleaching process with an example.	(3)
5.	Examine the role of microorganisms as bioscrubbers. Write its advantages.	(3)
6.	Relate the use of microorganisms in steroid transformation	(3)
7.	Examine the role of microbial nanoparticles in water treatment process.	(3)
8.	Antibiotics for food preservation can be obtained from microorganisms. Explain.	(3)
9.	Classify the microorganisms causing destruction of monuments with its possible effects.	(3)
10.	Explain the application of probiotics to human health.	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks.

Module 1

11.	Describe the characteristics of microorganisms which are used industrially.	(14)
12.	Define the term microbes as food. Elaborate the production and application of any one microbe used as food.	(14)

Module II

13.		Define a bio crust. Summarize a suitable method of restoration of eroded soils using bio crust technology.	(14)
14.		The solid wastes disposed from industries can be treated with microorganisms and be disposed of safely and can form a part of sustainable technique. Illustrate this with suitable examples.	(14)
Module III			
15.		Outline the role of microorganisms in conversion of lignocellulosic materials into food.	(14)
16.		Develop a bioremediation technique using microbial biofilms for the treatment of specific water pollutants.	(14)
Module IV			
17.		Define steroid transformation. Highlight the role of microorganisms in steroid transformation and compare the process with a normal fermentation process.	(14)
18.		Elaborate any one metabolic compound produced from microorganisms which can be used as an immunosuppressive agent.	(14)
Module V			
19.		Summarize the role of microbial nanoparticles in the treatment of water.	(14)
20.	a	Define biocalcification. Illustrate the role of halophilic bacteria in the biocalcificaation process	(8)
	b	Highlight the role of microorganisms in destruction of monuments and one method to control the degradative process. (6)	(6)
***			

Syllabus

Module 1:

An overview of application of microorganisms in various fields. Definition and scope of applied microbial technology. Biotechnological applications of microorganisms in industry.: Overview, Characteristics of microorganisms used in industries and other fields. Advantages and disadvantages of application of microbes in various sectors

Application of microorganisms in food industry: Microbial production of fermented foods; dairy products, Distilled and undistilled beverages. Probiotics technology; Role of microorganisms.

Microbes as food: SCP, fungal protein- yeast and algal proteins - *Chlorella* and *Spirulina*-production and application .

Module 2: Microorganisms in waste management: Urban waste management using microorganisms, Management of solid wastes from industries, Agriculture. Biogas production. Microorganisms in sewage treatment, waste treatment, sludge treatment and hyacinth pond.Application of microorganisms in soil and agriculture : Microbes in waste land development and forestry, bio crust application: A potential tool in restoration. Application of mycorrhizal fungi in agriculture and forestry. Microorganisms in mine waste soil and soil waste recycling.

Module 3: Use of microorganisms in environment problem solving : Role of microorganisms in bioconversion of lignocellulosic materials into food and feed.Microbes for renewable energy production, remediation of water pollutants using biofilms, Role of microorganisms in degradation of pesticides: DDT and Endosulfan. Probiotic bacteria and their importance in Aquaculture. Microbial seeding and Engineering approaches to Bioremediation; Microbial biofilm and bioremediation process. Microorganisms as sinks for bioscrubbers and biofilters. Microbes in mining and recovery of ore. Bacterial leaching and biomining.

Module 4: Microbial production of therapeutic compounds ; Microbial cell factories : Characteristics of microorganisms used in the production of therapeutics and biologicals. Microbial production of neutrceuticals.: Bacteria and yeast as producers or catalysts in the production of neutraceuticals. Microbes as antitumor drugs and enzyme inhibitors : Microbes used in immunosuppressant : Role of cyclosporins and Tacrolimus as immunosulppressive agents.

Steroid biotransformation: role of microorganisms, catalysis of steroids by microbial enzymes

Module 5

Applied microbial technology approaches in Archeology.: Microorganisms deteriorating wood and stone monuments. Methods of control of microbes for preservation of archaeological objects.

Microorganisms and Their Enzymes as Bio restoration Agents : Use of viable microbial cultures and their enzymes in bio cleaning.

Bioconsolidation: Biocalcifying bacteria and their uses. *Biocalcification* by halophilic *bacteria* for remediation of concrete structures; Biocementation

Microbial nanotechnology: Microbial nanoparticles; nanotechnology for water treatment process.

Nanocarbon balls as deodorizer in fermentation process.

REFERENCE BOOKS

1. Recent Advances in Marine Biotechnology. Vol.2 (1998) Fingerman, M., Nagabushanam, R., Thompson, M
2. Environmental Biotechnology : Theory and applications; Gareth M Evans and Judith C Furlong
3. Bioremediation; Applied microbial solutions for real world Environmentl clean up; Ronald M Atlas and Jims Phipp.
4. Microbes and Microbial Technology (2014 Agricultural and Environmental Applications Iqbal Ahmad (Editor), Farah Ahmad (Editor), John Pichtel (Editor)
5. Microbial nanotechnology ; Mahendra Rai and Patrycja Golinska (2020)

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	An overview of application of microorganisms in various fields Application of microorganisms in food industry.	
1.1	Definition of applied microbial technology, scope of applied microbial technology , Characteristics of microorganisms used in various industries. Advantages and disadvantages of use of microorganisms used in various fields	2
1.2	Microbial production of fermented foods; dairy products, Distilled and undistilled beverage	2
1.3	Probiotic technology : Role of microorganisms, advantages and disadvantages with case studies	1
1.4	Microbes as food: SCP, fungal protein- yeast and algal proteins - Chlorella and Spirulina- production and application.	2
2	Microorganisms in waste management Application of microorganisms in soil and agriculture :	
2.1	Urban waste management using microorganisms, Management of solid wastes from industries, Agriculture. Biogas production.	2
2.2	Microorganisms in sewage treatment, waste treatment, sludge treatment and hyacinth pond.	1
2.3	Application of microorganisms in soil and agriculture : Microbes in waste land development and forestry	2
2.4	Role of biocrusts in stabilizing soil surfaces: A potential tool in restoration. Application of mycorrhizal fungi in agriculture and forestry.	2
3	Use of microorganisms in environment problem solving Microbial seeding and Engineering approaches to Bioremediation	
3.1	Role of microorganisms in bioconversion of lignocellulosic materials into food and feed. Microbes for renewable energy production.	2
3.2	Remediation of water pollutants using biofilm, Role of microorganisms in degradation of pesticides: DDT and Endosulfan.	2
3.3	Probiotic bacteria and their importance in Aquaculture.	1
3.4	Microbial seeding and Engineering approaches to Bioremediation; Microbial biofilm and bioremediation process. Microorganisms as sinks for bioscrubbers and biofilters.	2
3.5	Microbes in mining and recovery of ore. Bacterial leaching and biomining.	1
4	Microbial production of therapeutic compounds	

4.1	Microbial cell factories: characteristics of the microbial strains used to produce therapeutic compounds and biological products.	2
4.2	Microbial production of neutrceuticals.: Bacteria and yeast as producers or catalysts in the production of neutraceuticals.	2
4.3	Microbes as antitumor drugs and enzyme inhibitors	1
4.4	Microbes used in immunosuppressant : Role of cyclosporins and Tacrolimus as immunosulppressive agents.	1
4.5	Steroid biotransformation: role of microorganisms, catalysis of steroids by microbial emzymes.	1
5	Applied microbial technology approaches in Archeology Microbial nanotechnology	
5.1	Microorganisms deteriorating wood and stone monuments. Methods of control of microbes for preservation of archaeological objects.	2
5.2	Microorganisms and Their Enzymes as Bio restoration Agents : Use of viable microbial cultures and their enzymes in bio cleaning.	1
5.3	Bioconsolidation: Biocalcifying bacteria and their uses. *Biocalcification* by halophilic *bacteria* for remediation of concrete structures, Biocementaation.	2
5.4	Microbial nanoparticles; nanotechnology for water treatment process. Nanocarbon balls as deodorizer in fermentation process.	1
	Total lecture hours	**35**

SEMESTER VII
OPEN ELECTIVE

BTT415	INDUSTRIAL BIOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: Have a clear knowledge in various bioprocessing methods and manufacture of bioproducts.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Differentiate between traditional and modern biotechnology as well as upstream and downstream processing in bioprocess
CO 2	Analyze the microorganisms used in agriculture and food industries
CO 3	Explain the production of primary metabolites.
CO 4	Illustrate the production of pharmaceutical and bioenergy production.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	3	-	-	-	-	-	-
CO2	-	-	3	-	-	3	-	-	-	-	-	-
CO3	-	-	3	-	-	3	3	-	-	-	-	-
CO4	3	-	-	-	-	3	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Differentiate between traditional and modern biotechnology as well as upstream and downstream processing in bioprocess

1. Give an account of various organisms used in modern biotechnological process.
2. Illustrate with block diagram the process flow sheet of a bioprocess.
3. With a neat sketch outline the upstream processes involved in the fermentation process.

Course Outcome 2 (CO2): Analyze the microorganisms used in agriculture and food industries

1. Draw a neatly labelled diagram and explain the microbial production of vinegar.
2. Discuss the role of microorganisms in cheese production.
3. Brief about the processes involved in the production of biopesticides.

Course Outcome 3(CO3): Explain the production of primary metabolites.

1. Distinguish between primary and secondary metabolite.
2. Discuss the production process of amylase enzyme.
3. Detail about the production process of anyone amino acid.

Course Outcome 4 (CO4): Illustrate the production of pharmaceutical and bioenergy production.

1. With a neat layout discuss the synthesis of vaccine.
2. Summarize the role of genetically modified organisms in the monoclonal antibody production.
3. Justify the concept of “green energy” stating the advantages and disadvantages of biogas production.

Model Question Paper

			Total Pages:
Reg No		Name:	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION____20___

Course Code: BTT415

Course Name: INDUSTRIAL BIOTECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.		Give any three examples each for traditional and modern fermentation process.	(3)
2.		Explain downstream processing.	
3.		Draw the flow diagram of microbial production of Xanthan gum.	(3)
4.		Write note on the organisms involved in the biofertilizers.	(3)
5.		With a growth curve explain the characteristics of log phase.	(3)
6.		Name the organisms and substrates used for cellulose production.	(3)
7.		Outline the mode of action of penicillin.	(3)
8.		What are interferons?	(3)
9.		Discuss about bioremediation.	(3)
10.		Demonstrate a biorefinery.	(3)

PART B

Answer any one full question from each module. Each carry 14 marks.

11		With the help of a neatly labelled flow diagram, explain the upstream and downstream operations involved in a bioprocess.	(14)
		OR	
12		Explain the market potential of biotechnology in detail.	(14)
13		Briefly describe the production of biofertilizers.	(14)
		OR	
14		Sketch the developmental process of a biopesticide.	(14)
15		Detail about the production process of any amino acid.	(14)
		OR	
16		Explain about the industrial production of amylase.	(14)
17		Brief about how insulin is manufactured in a commercial scale.	(14)

		OR	
18		Explain about the production process of streptokinase.	(14)
19		Write detailed note on biodiesel production.	(14)
		OR	
20		What are the methods employed for the production of biogas?	(14)
		***	

Syllabus

Module 1: Introduction to Industrial bioprocess

Commercial potential of Biotechnology in India. Historical overview of industrial fermentation process. Traditional and modern biotechnology. A brief outline of organisms, processes and products, Upstream and downstream processes in bioprocessing, Process flowsheet- block diagrams.

Module 2: Microbes in agriculture and food industry

Beneficial soil microbes, Biofertilizers and biopesticides, SCP, Microbial production of wine, beer and vinegar, biopreservatives (Nisin), cheese, biopolymers (Xanthan gum, PHB etc). Microbial production of flavours and fragrances, microbial pigments in textile and food industry.

Module 3: Production of primary metabolites

Production of ethanol, acetone, butanol, citric acid, dextran, aminoacids, enzymes such as proteases, amylases, lipases and cellulases

Module 4: Production of pharmaceutical products

Antibiotics like penicillin, cephalosporin, vitamin B-12, Insulin, Interferon, Streptokinase, Vaccines, Monoclonal antibodies

Module 5: Bioenergy

Fuel from biomass, Biodiesel, biogas, biorefineries, Bioremediation

Text Books

1. Kumar, H.D. "*A Textbook on Biotechnology*" 2nd Edition. Affiliated East West Press Pvt. Ltd., 1998.
2. Dubey, R.C. "*A Textbook of Biotechnology*" S.Chand & Co. Ltd., 2006
3. Satyanarayana, U. "*Biotechnology*" Books & Allied (P) Ltd., 2005.

Reference Books

1. Casida, L.E. "Industrial Microbiology" New Age International (P) Ltd,1968
2. Presscott, S.C and Cecil G. Dunn "Industrial Microbiology" Agrobios (India), 2005
3. Cruger Wulf and Anneliese Cruger, "Biotechnology: A textbook of Industrial *Microbiology*" 2nd Edition, Panima Publishing, 2000.
4. Moo Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press (An Imprint of Elsevier),2004.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to Industrial bioprocess**	
1.1	Commercial potential of Biotechnology in India. Historical overview of industrial fermentation process.	1
1.2	Traditional and modern biotechnology. A brief outline of organisms, processes and products,	2
1.3	Upstream and downstream processes in bioprocessing,	2
1.4	Process flowsheet- block diagrams.	1
2	**Microbes in agriculture and food industry**	
2.1	Beneficial soil microbes, Biofertilizers and biopesticides,	1
2.2	SCP, Microbial production of wine, beer and vinegar	2
2.3	Biopreservatives (Nisin), cheese, biopolymers (Xanthan gum, PHB etc).	3
2.4	Microbial production of flavours and fragrances, microbial pigments in textile and food industry.	1
3	**Production of primary metabolites**	
3.1	Production of ethanol	1
3.2	Acetone, butanol, citric acid	2
3.3	Dextran, aminoacids	2
3.4	Enzymes such as proteases, amylases, lipases and cellulases	2
4	**Production of pharmaceutical products**	
4.1	Antibiotics like penicillin, cephalosporin	2
4.2	Vitamin B-12,	1
4.3	Insulin, Interferon, Streptokinase	2
4.4	Vaccines, Monoclonal antibodies	2
5	**Bioenergy**	
5.1	Fuel from biomass	2
5.2	Biodiesel	2
5.3	Biogas	2
5.4	Biorefineries, Bioremediation	2
	Total lecture hours	**35**

BTT425	BASICS IN BIOINFORMATICS & DRUG DESIGN	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: Study the basic concepts of Bioinformatics and drug designing

Prerequisite: Basic knowledge of molecular biology and chemistry

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the basic principles of Drug design and development and the sequence of events necessary to bring a drug to market
CO 2	Understand and retrieve information obtained in the different phases of drug development
CO 3	Analyze how the sources and the methods for predictions are
CO 4	used to make early decisions in the drug discovery and development

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	3	2	-	-	-	-	-	-
CO2	2	3	2	1	3	3	-	-	-	-	-	-
CO3	3	2	2	2	3	2	-	-	-	-	-	-
CO4	2	3	2	1	3	3	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:
There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. S students should answer all questions. Part B contains 2 questions from each module of which students should answer any one. Each question can have a maximum of 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions (Minimum 3 questions per CO)

Course Outcome 1 (CO 1): Understand the basic principles of Drug design and development and the sequence of events necessary to bring a drug to market

1. Explain the Drug discovery process–traditional approach and rational approach.
2. Explain the various Patent Protection and regulation schemes in the pharmaceutical industry.
3. Explain Computer-Aided Drug Discovery– importance and significance.

Course Outcome 2 (CO 2): Understand and retrieve information obtained in the different phases of drug development

1. Analyze the various Open Source and Commercial in silico tools and software Databases
2. Explain the various Structure drawing software

Course Outcome 3(CO 3): Analyse how the sources and the methods for predictions are used to make early decisions in the drug discovery and development

1. Analyze and apply the Structure-Based Drug Designing
2. Apply Molecular and quantum mechanics
3. Analyze the drug and the receptor interactions using Molecular docking techniques

Course Outcome 4 (CO 4): Design novel drugs using pharmacophore modeling and docking technique

1. Analyze the Quantitative Structure-Activity Relationship
2. Apply QSAR with molecular field analysis (MFA)
3. Comparative molecular field analysis (CoMFA).
4. Explain the various Statistical methods used in QSAR analysis.
5. Validate QSAR model

Model Question Paper

		Total Pages:2
Reg No.:_______________		Name:____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION

Course Code: BTT425

Course Name: BASICS IN BIOINFORMATICS AND DRUG DESIGN

Max. Marks: 100	Duration: 3 Hours

PART A

		Answer all questions each carries 3 marks	Marks
1.		Write any three examples of chemical software programs	(3)
2.		Explain the rationale drug discovery process	(3)
3.		State and name the equation that is the starting point of the wave mechanical approach to molecular modeling	(3)
4.		Explain the descriptors in QSAR analysis	(3)
5.		Explain the molecular clock hypothesis	(3)
6.		Differentiate between in vitro and in vivo experiments	(3)
7.		Define pharmacophore	(3)
8.		Name any three statistical methods used in QSAR analysis	(3)
9.		Explain the purpose of scoring functions	(3)
10.		Explain the bioactive conformation of a molecule	(3)

PART B

Answer any two full questions from each module. Each carries 14 marks.

11.	a	Explain how existing Drugs could be an attractive source in Drug design.	(7)
12.	b	Explain any four advantages and disadvantages of web-based tools in drug discovery	(7)
		OR	
13.		Explain any three structure drawing software	(14)
14.		Explain the process of constructing a model protein using homology modeling	(14)

OR			
15.	a	Explain Molecular docking and drug-receptor interactions	(7)
	b	Explain Ramachandran plot	(7)
16.		Explain the Langevin method and QM method	(14)
OR			
17.		Explain automated de- Novo drug design	(14)
18.		Explain the model building and screening SAR of Penicillin G	(14)
OR			
19.		Explain the qualitative and quantitative approaches of structure Activity Relationship	(14)
	b	Explain any two Statistical methods used in QSAR analysis	(14)
		OR	
20.		Explain 3D–QSAR approaches and contour map analysis	(14)
****			

Syllabus

Module I

Basics of Drug Designing and Introduction to Computer-aided drug designing: Drug discovery process–traditional approach and rational approach. Drug-discovery phase–preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance. Patent Protection, regulation, the future of the pharmaceutical industry. Introduction to Computer-Aided Drug Discovery–importance and significance. Internet as a source of –BIG DATA–Introduction to Open Source and Commercial in silico tools and software Datases- Drug Bank, Dr. Duke's Phytochemicals, Binding Database, TTD, Kegg, Pub Chem, ChEMBL. Structure drawing software–ChemDraw, Marvin Sketch, ACD/Chemsketch, Maestro Homology Modeling-Modeller, Prime, SWISS Model Docking–Argus Lab, Autodock, FLOG, Cdocker, Glide QSAR–PaDEL, QSARINS, PHAKISO ADMET–PreADME, ADMETox

Module II.

Structure-Based Drug Designing–1: Structure-based drug designing: Target identification and Validation Protein mapping: Constructing a model protein– homology modeling, Validation of protein models– Ramachandran plot, binding site identification- Receptor Grid generation.

Molecular and quantum mechanics: (Choice of the method for energy minimization for ligand and protein) Lead optimization: Conformational Analysis: local and global energy-minima, identification of bioactive conformation. Bioactive vs. global-minimum conformations. Molecular docking and drug-receptor interactions: Rigid docking, flexible docking, and extra precision docking. Docking Software's–ArgusLab and Autodock.

Module III

Structure-Based Drug Designing-2

Molecular dynamics: Dynamics of drugs, biomolecules, drug-receptor complexes, Idea about the classical method, Langevin method, QM method. Molecular Dynamics using simple models. Monte Carlo simulations and Molecular dynamics in performing a conformational search. De Novo Drug Design–General principles, Automated de- Novo drug design–LUDI, SPROUT, LEGEND Scoring: energy Expression and consensus scoring, binding free energy, solvation, Ligands covalently bound to the active site, Matrices of the goodness of fit.

Module IV

Ligand Based Drug Designing–1: Structure-Activity Relationships in Drug Design:

Structure-Activity Relationship. Qualitative and quantitative approaches–advantages and disadvantages of the two approaches. Homologation, chain branching, ring-chain transformations, bioisosterism. Insights into molecular recognition phenomenon. Pharmacophore model–Identification of pharmacophore, model building, and screening SAR of Penicillin G, Barbiturates, Isoniazid

Module V

Ligand Based Drug Designing–2: Quantitative Structure-Activity Relationship- Quantitative structure-activity relationship: QSAR Parameters–Lipophilicity, electronic and steric factors. Experimental and theoretical approaches for the termination of these physicochemical parameters (descriptor generation). Quantitative Models–Hansch analysis, FreeWilson analysis, mixed approach. QSAR, 3D–QSAR approaches, and contour map analysis. QSAR with molecular field analysis (MFA) and comparative molecular field analysis (CoMFA).

Statistical methods used in QSAR analysis and the importance of statistical parameters. Regression analysis, extrapolation versus interpolation, linearity versus non-linearity. Validation of QSAR model. OECD Principle. Importance of Internal and external validation.

Recommended books main reading

1. Claverie, J.M., and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 2001 Bioinformatics: The machine learning approach, The MITPress.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWSPublishing Co., Boston.
5. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.
6. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
7. Mount, D.W., Bioinformatics: 2001, Sequence and Genome Analysis. CSHL Press.
8. Durbin R., Eddy S., Krogh A., and Mitchison G. 2007 Biological Sequence Analysis, CambridgeUniversity Press.

References

1. E. Stevens, Medicinal Chemistry–The Modern Drug Discovery Process, Pearson, 2014.
2. V. K. Ahluwalia and Madhu Chopra, Medicinal Chemistry, Anes Student Edition, 2008
3. Graham L. Patrick, An Introduction to Medicinal Chemistry, Oxford University Press, 1995.
4. J. Goodman, Chemical applications of molecular modeling RSC, 1999

Suggested Readings

1. Durbin R., Eddy S., Krogh A., and Mitchison G. 2007 Biological Sequence Analysis, Cambridge University Press.
2. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.
3. Fogel, G.B. and Corne, D.W., 1997 Evolutionary Computation in Bioinformatics.

4. Rastogi et al 2003. Bioinformatics: Concepts, Skills, and Applications. CBS
5. Rashidi and Buchler 2000. Bioinformatics Basics. CRC Press
6. Mount, D.W., Bioinformatics 2004. Sequence and Genome Analysis. CSHL Press

Course Contents and Lecture Schedule

Module	Course Contents and Lecture Schedule	No. of Hrs:35
1.0	**Basics of Drug Designing and Introduction to Computer aided drug designing**	**7**
1.1	Drug discovery process–traditional approach and rational approach.	1
1.2	Drug discovery phase–preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.	2
1.3	Patent Protection, regulation, the future of the pharmaceuticalindustry	1
1.4	Introduction to Computer Aided Drug Discovery–importance and significance.	1
1.5	Internet as a source of –BIG DATA–Introduction to OpenSource and Commercial in silico tools and software Datases- Drug Bank, Dr. Duke's Phytochemicals, Binding Database, TTD, Kegg, Pub Chem, ChEMBL Structure drawing software–ChemDraw, Marvin Sketch, ACD/Chemsketch, Maestro Homology Modeling- Modeller, Prime, SWISS Model Docking–Argus Lab, Autodock, FLOG, Cdocker, Glide QSAR–PaDEL, Excel, QSARINS, PHAKISO ADMET–PreADME, ADMETox	2
2.0	**Structure-Based Drug Designing–1**	**7**
2.1	Structure-based drug designing: Target identification and Validation Protein mapping: Constructing a model protein– homology modeling, Validation of protein models– Ramachandran plot, binding site identification- Receptor Grid generation.	2
2.2	Molecular and quantum mechanics: (Choice of the method for energy minimization for ligand and protein)	1
2.3	Lead optimization: Conformational Analysis: local and global energy minima, identification of bioactive conformation. Bioactive vs. global minimum conformations.	2

2.4	Molecular docking and drug- receptor interactions: Rigid docking, flexible docking, and extra precision docking. Docking Software's–ArgusLab and Autodock.	2
3	**Structure-Based Drug Designing-2**	**6**
3.1	Molecular dynamics: Dynamics of drugs, biomolecules, drug-receptor complexes, Idea about the classical method, Langevin method, QM method. Molecular Dynamics using simple models. Monte Carlo simulations and Molecular dynamics in performing a conformational search.	2
3.2	De Novo Drug Design–General principles, Automated de-Novo drug design–LUDI, SPROUT, LEGEND	2
3.3	Scoring: energy Expression and consensus scoring, binding free energy, solvation, Ligands covalently bound to the the active site, Matrices of the goodness of fit	2
4.0	**Ligand Based Drug Designing–1: Structure-Activity Relationships in Drug Design**	**7**
4.1	Structure-Activity Relationship. Qualitative and quantitative approaches–advantages and disadvantages of the two approaches.	2
4.2	Homologation, chain branching, ring-chain transformations, bioisosterism. Insights into molecular recognition phenomenon.	2
4.3	Pharmacophore model–Identification of pharmacophore, model building, and screening	2
4.4	SAR of Penicillin G, Barbiturates, Isoniazid	1
5.0	**Ligand Based Drug Designing–2: Quantitative Structure-Activity Relationship**	**8**
5.1	Quantitative structure activity relationship: QSAR Parameters–Lipophilicity, electronic and steric factors.	1
5.2	Experimental and theoretical approaches for the determination of these physicochemical parameters (descriptor generation).	1
5.3	Quantitative Models–Hansch analysis, Free Wilson analysis, mixed approach.	1
5.4	QSAR, 3D–QSAR approaches and contour map analysis.QSAR with molecular field analysis (MFA) and comparative molecular field analysis (CoMFA).	2

5.5	Statistical methods used in QSAR analysis and the importance of statistical parameters. Regression analysis, extrapolation versus interpolation, linearity versus non-linearity.	2
5.6	Validation of QSAR model. OECD Principle. Importance of Internal and external validation.	1
	Total lecture hours	**35**

BTT435	SUSTAINABLE ENERGY PROCESS	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble:
Study in detail the energy resources

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the need for developing sustainable energy processes
CO 2	Assess the technology behind sustainable energy processes, its merits and demerits
CO 3	Explain the various processes involved in the conversion of biomass, wind, solar, tidal energy and geothermal energy into useful energy
CO 4	Analyze the working of fuel cells and energy storage routes

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	2	-	-	-	-	3	-	-	-	-	-
CO2	-	2	-	-	-	-	3	-	-	-	-	-
CO3	-	-	2	-	-	-	3	-	-	-	-	-
CO4	-	-		-	-	-	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the need for developing sustainable energy processes

1. Justify the need of utilizing the potential renewable energy resources.
2. List the problems associated with the use of fossil fuels.
3. How sustainable energy processes different from conventional energy conversion processes?

Course Outcome 2 (CO2): Assess the technology behind sustainable energy processes, its merits and demerits

1. Explain the principle and working of photo voltaic system.
2. Describe working principles of solar pond energy conversion system.
3. Compare the advantages and limitation of alkaline fuel cell and phosphoric acid fuel cell

Course Outcome 3 (CO3) Explain the various processes involved in the conversion of biomass, wind, solar, tidal energy and geothermal energy into useful energy

1. Differentiate pyrolysis and gasification?
2. Outline various steps involved in gasification process
3. Briefly explain the process of Biogas formation

Course Outcome 4 (CO4) Analyze the working of fuel cells and energy storage routes

1. Compare the advantages and limitation of alkaline fuel cell and phosphoric acid fuel cell.
2. Explain various energy storage techniques.
3. Differentiate fuels cells from batteries.

Model Question Paper

			Total Pages:
Reg No.:_________		Name:_________________________ _	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SEVENTH SEMESTER B. TECH DEGREE EXAMINATION____20___			
Course Code: BTT435			
Course Name: SUSTAINABLE ENERGY PROCESSES			
Max. Marks: 100		Duration: 3 Hours	
		Answer all questions each carries 3 marks	Marks
1.		Justify the need for exploring sustainable energy resources.	(3)
2.		Identify the problems due to the usage of fossil fuels.	(3)
3.		Compare and contrast the advantages and disadvantages of Hydropower Energy	(3)
4.		Summarize semiconductor & thin film technology.	(3)
5.		Write short note on safety & environmental aspects of wind turbines.	(3)
6.		Write short note on storage of wind energy.	(3)
7.		With the help of diagram, discuss the power versus wind speed characteristic of a wind turbine.	(3)
8.		List out the various Biomass conversions techniques.	(3)
9.		Justify the need for exploring sustainable energy resources.	(3)
10.		Identify the problems due to the usage of fossil fuels.	(3)
PART B			
Answer any two full questions from each module. Each carries 14 marks.			
11.	a) b)	Explain the global energy scenario Disadvantages of conventional energy source	(7) (7)
		OR	
12.	a) b)	Illustrate renewable energy source's potentials and applications How sustainability can be incorporated in energy sector?	(7) (7)
13.	a) b)	Describe the hydro power generation scenario in the world and compare the same with Indian scenario. With the help of neat sketch, explain solar photovoltaic power generation	(7) (7)
		OR	
14.		Outline the Merits and limitations of solar energy and hydropower	(14)
15.	a) b)	Differentiate between HAWT and VAWT in detail. Point out the merits & limitations of wind energy	(7) (7)
		OR	

16.		Explain in detail closed and open geothermal power plants	(14)
17.	a) b)	Compare biodiesel and Diesel and give your Inference Explain the production of Bioethanol from three types of feed stocks	(7) (7)
		OR	
18.	a)	Explain the technology behind Ocean thermal energy conversion	(7)
	b)	What are the challenges to be addressed in biomass conversion technologies	(7)
19.	a) b)	Justify the need of energy storage Compare and contrast the emerging energy storage techniques	(7) (7)
		OR	
20.	a) b)	Compare the advantages and limitation of alkaline fuel cell and phosphoric acid fuel cell. Define magneto-hydro dynamics and their working principle.	(7) (7)
		***	

Syllabus

Module 1: General classification of energy

Conventional and non- conventional. Renewable and non-renewable. Global and Indian energy sources. Global and Indian energy consumption. Problems of fossil fuels. Environmental aspectsof energy utilization. Energy and sustainable development. Energy planning. Renewable energy sources-potentials, achievements and applications.

Module 2: Solar energy and Hydropower

Solar radiation. Solar thermal systems. Flat plate and concentrating collectors. Solar desalination. Solar pond. Solar cookers. Solar dryers. Solar thermal electric power plant. Semiconductor and thin film technology. Solar cells. Solar photovoltaic power generation. Hybrid systems. Electricity from hydropower. Small hydropower. Merits and limitations of solar energy and hydropower.

Module 3: Wind and Geothermal energy

Availability of wind energy, Site characteristics, Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine. Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy. Geothermal energy conversion, Geothermal power plant.

Module 4: Biomass energy and Energy from the oceans.

Biomass resources, Biomass conversion technologies-direct combustion, pyrolysis, biomass gasification. Biogas, Bioethanol, biodiesel and biobutanol production Storage of hydrogen. Ocean thermal electric conversion (OTEC). Tidal energy conversion. Wave energy conversion.

Module 5: Emerging Technologies

Fuel cells- Alkaline fuel cells. Phosphoric acid fuel cell. Molten carbonate fuel cell. Solid oxide fuel cell, Solid polymer electrolyte fuel cell. Magneto-hydrodynamic systems. Electric vehicles. Hydrogen Energy. Biohydrogen production. Energy storage routes like thermal,chemical, mechanical, electrical storage.

Text Books

1. Abbasi S. A. and N. Abbasi, *Renewable Energy Sources and Their Environmental Impact*, Prentice Hall of India, 2001.

2. Boyle G. (ed.), *Renewable Energy - Power for Sustainable Future*, Oxford University Press, 1996

Reference Books

1. Bansal N K, Kleemann M, Michael Meliss, *Renewable Energy Sources & ConversionTechnology,* Tata McGraw Hill publishing Company, New Delhi, 1990.

2. Boyle, Godfrey*, Renewable Energy*, 3/e, Oxford University Press, 2012

3. S P Sukhatme, *Solar Energy - Principles of Thermal Collection and Storage*, 2/e, TataMcGraw- Hill Publishing company, New Delhi,1996.

4. Pramod Jain, *Wind Energy Engineering*, McGraw Hill, 2011.

5. Donald L Klass, *Biomass for Renewable Energy, Fuels and Chemicals*, Academic Press, 1998

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**An overview of conventional and non-conventional energy sources**	
1.1	Conventional and non- conventional. Renewable and non-renewable.	1
1.2	Global and Indian energy sources. Global and Indian energy consumption	1
1.3	Problems of fossil fuels. Environmental aspects of energy utilization. Energy and sustainable development. Energy planning.	2
1.4	Renewable energy sources, potentials, achievements and applications	2
2	**Solar energy and Hydropower**	
2.1	Solar radiation. Solar thermal systems. Flat plate and concentrating collectors.	1
2.2	Solar pond. Solar cookers. Solar dryers. Solar thermal electric power plant actors	2
2.3	Solar photovoltaic conversion. Semiconductor and thin film technology. Solar cells. Solar photovoltaic power generation. Hybrid systems	2
2.4	Electricity from hydropower. Small hydropower. Merits and limitations of solar energy and hydropower	2
3	**Wind and Geothermal energy**	
3.1	Availability of wind energy, Site characteristics	1
3.2	Wind turbine types-horizontal axis and vertical axis-design principles of wind turbine	2
3.3	Wind power plants, Wind energy storage. Safety and environmental aspects. Merits and limitations of wind energy	2
3.4	Geothermal energy conversion, Geothermal power plant.	2
4	**Biomass energy and Energy from the oceans.**	
4.1	Biomass resources, Biomass conversion technologies-.	1
4.2	Direct combustion, pyrolysis, biomass gasification.	2
4.3	Biogas, Bioethanol, biodiesel and biobutanol production.	2
4.4	Ocean thermal electric conversion. Tidal energy conversion. Wave energy conversion.	2
5	**Emerging Technologies**	
5.1	**Fuel cells-** Alkaline fuel cells. Phosphoric acid fuel cell. Molten carbonate fuel cell. Solid oxide fuel cell, Solid polymer electrolyte fuel cell.	2

5.2	Magneto-hydrodynamic systems. Electric vehicles.	2
5.3	Hydrogen as fuel and its storage. Biohydrogen production	2
5.4	Energy storage routes like thermal,chemical, mechanical, electrical storage.	2
	Total lecture hours	**35**

BTT 445	OCCUPATIONAL HEALTH AND GENERAL SAFETY	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble: Objective of this course is to introduce the fundamental principles of occupational health and general safety in a simple and up-front manner and to provide the broad background for applying these principles in industry. This course introduces students to basic concepts of occupational hazards and safety measures across various engineering streams.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to

CO1	To identify occupational diseases and toxicity in the workplace
CO2	To explain hazards related to noise, air, chemical, biological and radiation and their control
CO3	To explain the basic issues of electrical and civil work Hazards
CO4	To explain industrial effluent treatment and hazardous waste pollution

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2				3	2	1		1		
CO2	1	1	2	1	2	3	2	1		1		
CO3	1	1	2		1	3	1	2		1		
CO4	1	2	2	1	1	3	3	2		1		

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course level assessment questions

Course Outcome 1(CO1): To identify occupational diseases and toxicity in the workplace

1. Discuss about the major occupational related diseases.
2. Write about the various effects of heavy metal toxicity.
3. Differentiate between temporary and cumulative effects of industrial toxins.

Course Outcome 2 (CO2): To explain hazards related to noise, air, chemical, biological and radiation and their control

1. Discuss about the effects on health of noise pollution and industrial control measures.
2. Compare the control measures for various chemical hazards.
3. Explain the effects of radiation hazards and their control.

Course Outcome 3 (CO3): To explain the basic issues of electrical and civil work Hazards

1. Discuss the methods for protection against voltage fluctuations and electric shock.
2. What are the important safety constrains involved in transportation of men and material.
3. Outline the safety measures to be considered during concreting and cementing work.

Course Outcome 4 (CO4): To explain industrial effluent treatment and hazardous waste pollution

1. Discuss about the effluent treatment methods in petroleum industry.
2. Explain water pollutants and the associated health hazards.
3. Explain hazardous Wastes and illustrate how they are classified.

Model Question paper

			Total Pages:
Reg No.:____________		Name:	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER B. TECH DEGREE EXAMINATION______20____

Course Code: BTT 445

Course Name: OCCUPATIONAL HEALTH AND GENERAL SAFETY

Max. Marks: 100	Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.	*Marks*
1.		Explain the effect of chromium toxicity.	(3)
2.		Write a short note on Industrial Hygiene.	(3)
3.		Describe the toxic effects of chemical fog	(3)
4.		Discuss about noise exposure regulations.	(3)
5.		Explain effects of radiation on human body	(3)
6.		Explain the mechanism of acid rain formation	(3)
7.		What are the effects of shock on human body	(3)
8.		What are the safety points need to be considered during Welding and Cutting	(3)
9.		List out the major water pollutants	(3)
10.		Discuss briefly about effluent quality standards	(3)

PART B

Answer any one full question from each module. Each carries 14 marks.

11.		Elaborate occupational diseases with three examples.	(14)
		OR	
12.		Explain the heavy metal toxicity with three examples	(14)
13.		Classify and explain the various Biological hazard agents	(14)
		OR	
14.		Explain Noise pollution effects on human health and industrial control measures	(14)

15.		Differentiate the types of radiation and their effects on human body. Explain the disposal methods of radioactive waste	(14)
		OR	
16.		List out the major air pollutants and explain their effect on human health, animals, Plants and Materials	(14)
17.		Explain the various safety measures in construction industry	(14)
		OR	
18.		Explain the various methods to prevent electrical Hazards	(14)
19.		Classify hazardous wastes and explain their health hazards	(14)
		OR	
20.		Explain the pollution control method used in paper industry, textile industry and tanneries.	(14)

SYLLABUS

MODULE I : Occupational Health and Toxicology

Occupational Health and Toxicology : occupational related diseases, silicosis, asbestosis, pneumoconiosis, etc. Lead, nickel, chromium and manganese heavy metal toxicity, effects and prevention –Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects. Industrial Hygiene.

MODULE II : Noise pollution, Chemical and Biological hazards

Noise pollution, noise exposure regulation. Effects on health and control measures. Chemical hazards-dust, fumes, mist, vapor, fog, gases, Methods of Control. Biological hazards-Classification of Biohazardous agents – bacterial agents, viral agents, fungal, parasitic agents, infectious diseases.

MODULE III : Radiation Hazards and Air Pollution

Radiation Hazards, Types and effects of radiation on human body, disposal of radioactive waste Air Pollution - air pollutants from industries, effect on human health, animals, Plants and Materials - concept of clean coal combustion technology - depletion of ozone and acid rain

MODULE IV : Electrical and Civil work Hazards

Electrical Hazards, Protection against voltage fluctuations, Effects of shock on human body. Introduction of Construction industry, Scaffolding and Working platform, Welding and Cutting, Excavation Work, Concreting and Cementing work, Transportation of men and material

MODULE V : Industrial Effluent and Waste Pollution Control

Water Pollution -water pollutants and health hazards - effluent quality standards, tannery, textile effluents. Hazardous Waste Management -waste identification, characterization and classification, health hazards-toxic and radioactive wastes. Pollution Control in Industries - cement, paper, petroleum products, textile, tanneries, thermal power plants.

Text Books

1. Slote.L, Handbook of Occupational Safety and Health, John Willey and Sons, New York
2. R.K.Jain and Sunil S.Rao , Industrial Safety , Health and Environment Management Systems, Khanna publishers , New Delhi (2006)
3. S.P.Mahajan, “Pollution control in process industries”, Tata McGraw Hill Publishing
4. Company, New Delhi, 1993
5. Gerard Kiely, Environmental Engineering, McGraw hill Education

Reference Books

1. National Safety Council , Hand book of Occupational Safety and Health, Chicago, 1982
2. Mackenzie L Davis, Introduction to Environmental Engineering, McGraw hill Education (India)

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Occupational Health and Toxicology**	**6**
1.1	Occupational Health and Toxicology : occupational related diseases, silicosis, asbestosis, pneumoconiosis, etc	1
1.2	Lead, nickel toxicity, effects and prevention	1
1.3	Chromium and manganese toxicity, effects and prevention	1
1.4	Industrial toxicology, local, systemic and chronic effects	1
1.5	Industrial toxicology temporary and cumulative effects	1
1.6	Industrial Hygiene.	1
2	**Noise, Chemical and Biological hazards**	**5**
2.1	Noise pollution, noise exposure regulation, effects on health and control measures.	1
2.2	Chemical hazards-dust, fumes, mist, vapor, fog, gases	1
2.3	Chemical hazards methods of Control.	1
2.4	Biological hazards-Classification of Biohazardous agents – bacterial agents, viral agents,	1
2.5	Biological hazards- fungal, parasitic agents, infectious diseases.	1
3	**Radiation Hazards and Air Pollution**	**6**
3.1	Radiation Hazards, Types and effects of radiation on human body	1
3.2	Disposal of radioactive waste	1
3.3	Air Pollution - air pollutants from industries	1
3.4	Air Pollution - effect on human health, animals, Plants and Materials	1
3.5	Concept of clean coal combustion technology on biosafety	1
3.6	Depletion of ozone and acid rain	1
4	**Electrical and Civil work Hazards**	**9**
4.1	Electrical Hazards, Protection against voltage fluctuations	1
4.2	Effects of shock on human body	1
4.3	Introduction of Construction industry, Scaffolding and Working platform	2
4.4	Introduction of Construction industry- Welding, Cutting and Excavation Work	2
4.5	Introduction of Construction industry, Concreting and Cementing work	2
4.6	Transportation of men and material	1
5	**Industrial Effluent Waste Pollution Control**	**9**

5.1	Water Pollution -water pollutants	1
5.2	Water pollutants and health hazards	1
5.3	Hazardous Waste Management -waste identification, characterization and classification	2
5.4	Health hazards-toxic and radioactive wastes	1
5.5	Pollution Control in Industries - cement, paper	2
5.6	Control in Industries - petroleum products, textile,	1
5.7	Control in Industries - tanneries, thermal power plants	1
	Total lecture hours	**35**

BTT455	WASTE WATER ENGINEERING	CATEGORY	L	T	P	CREDIT
		OEC	2	1	0	3

Preamble:
Study in detail about the fundamentals of waste water and its treatment.

Prerequisite:
Fluid Flow and Particle technology, Mass Transfer Operations

Course Outcomes: After the completion of the course the student will be able to

CO 1	Know the basic characteristics of wastewater and the kinetics of biological system
CO 2	Use the knowledge of various waste water treatment methods society and environment.
CO 3	Compare the various sludge processing techniques.
CO 4	Select the adsorption and oxidation processes used for waste water treatment.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	2	2	1	2	2	-	-	-	-	1
CO2	3	2	3	1	-	2	2	-	-	-	-	2
CO3	1	2	1	-	-	2	2	-	-	-	-	-
CO4	2	2	1	-	-	1	1	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Know the basic characteristics of wastewater and the kinetics of biological system

1. Give the characteristics of waste water?
2. Select the types of reactors used for waste water treatment.
3. Outline the uses of an equalization tanks in waste water treatment plants.

Course Outcome 2 (CO2): Estimate the design and working principle of various waste water treatment methods

1. Write the nutrient and environmental requirements in activated sludge
2. Differentiate between single stage and two stage trickling filter.
3. Describe the important features of a biological contactor with the help of a neat sketch.

Course Outcome 3(CO3): Evaluate and compare various sludge processing techniques.

1. Write a note on sludge thickening and stabilization.
2. Describe about dewatering of sludge.
3. Explain the various methods used for disinfecting waste water.

Course Outcome 4 (CO4): Understand the adsorption and oxidation processes used for waste water treatment

1. Outline the various theories of adsorption?
2. Explain the various types of adsorption Isotherms.
3. Explain the chemical oxidation process for waste water treatment.

Model Question paper

			Total Pages:
Reg No.:		Name:	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGTH SEMESTER B. TECH DEGREE EXAMINATION___20

Course Code: BTT 455

Course Name: WASTE WATER ENGINEERING

Max. Marks: 100	Max. Marks: 100	Max. Marks: 100

PART A

		Answer all questions, each carries 3 marks.	***Marks***
1.		Outline the need of waste water characterization.	(3)
2.		Summarize the function of primary settling?	(3)
3.		List down the unit operations in primary treatment.	(3)
4.		Define detention time.	(3)
5.		Summarize the function of aeration in activated sludge process?	(3)
6.		Differentiate between HRT and SRT	(3)
7.		Define sludge volume index.	(3)
8.		Summarize about sludge recycling.	(3)
9.		Comment on adsorption equilibria.	(3)
10.		Give the advantages of ion exchange process?	(3)

PART B

Answer any one full question from each module. Each carries 14 marks.

11.		Explain about grit chamber and their design criteria. How do you classify screens based on the size of clear openings?	(14)
		OR	
12.		Enunciate the construction, working and applications of a rapid and slow sand filter.	(14)
13.		Describe sedimentation for water treatment. What are its purposes?	(14)
		OR	
14.		Differentiate between Aerobic Attached growth and Aerobic suspended growth treatment systems.	(14)
15.		Describe the principle of activated sludge process. What is the advantage of recycling of **sludge** in this process? Also explain the various modifications of the process giving specific features of each of them with respect to design and operation.	(14)
		OR	

16.		Explain the theoretical principle of trickling filter. Also enunciate the design considerations and list out the operational problems in standard rate trickling filters and list out their remedies.	(14)
17.		What are the effects of major operational and environmental variables on suspended-growth nitrification process? Explain different types of attached growth denitrification systems.	(14)
		OR	
18.		What do you mean by sludge digestion? Explain the working of sludge digestion tank with the help of a neat diagram.	(14)
19.		Explain the principle of adsorption. Explain the different type of ion exchange systems.	(14)
		OR	
20.		Describe the working of various advanced oxidation processes.	(14)

Syllabus

Module 1 Objectives of wastewater treatment

Characteristics, flow variations, types of reactors and reactors analysis. Wastewater Treatment Flow Diagrams and Hydraulic Profile. Theoretical principles and design considerations - screens, equalization basin, grit chamber, primary and secondary settling tanks.

Module 2: Unit operation

Screening, flow equalization, mixing, flocculation, sedimentation. Chemical unit processes-chemical precipitation. Biological unit processes: Aerobic attached growth and aerobic suspended growth treatment processes, anaerobic suspended growth treatment processes

Module 3: Theoretical principles and design considerations

Suspended growth system - conventional activated sludge process and its modifications. Theoretical principles and design considerations – attached growth system – trickling filter, bio-btt 43towers and rotating biological contactor

Module 4: Sludge Processing

Separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic. Sludge handling and removal. Nitrification and De-nitrification Processes, Phosphorous removal. Wastewater disinfection

Module 5: Adsorption and oxidation process.

Chemical process –adsorption-theory of adsorption-ion exchange process-Chemical oxidation-advanced oxidation process-miscellaneous treatment process.

Text Books

1. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. "Wastewater Treatment Concepts and Design Approach", Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi

Reference Books

1. Fair G.M., Geyer J.G and Okun, "Water-wastewater Engineering".
2. "Wastewater Engineering - Treatment and Reuse", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Objectives of wastewater treatment**	
1.1	Characteristics, flow variations, types of reactors and reactors analysis	2
1.2	Wastewater Treatment, Flow Diagrams and Hydraulic Profile.	1
1.3	Theoretical principles and design considerations - screens, equalization basin	2
1.4	Theoretical principles and design considerations- grit chamber, primary and secondary settling tanks. Types of filters	2
2	**Unit operation**	
2.1	Screening, flow equalization, mixing	2
2.2	Flocculation, Sedimentation. Chemical unit processes-chemical precipitation.	1
2.3	Biological unit processes: Aerobic attached growth and aerobic suspended growth treatment processes	2
2.4	Anaerobic suspended growth treatment processes	2
3	**Theoretical principles and design considerations**	
3.1	Suspended growth system - conventional activated sludge process and its modifications	2
3.2	Theoretical principles and design considerations – attached growth system	2
3.3	Theoretical principles and design considerations – trickling filter	2
3.4	, Theoretical principles and design considerations – bio-towers and rotating biological contactor	2
4	**Sludge Processing**	
4.1	Separation - sludge thickeners, volume reduction	1
4.2	Conditioning and digestion – aerobic and anaerobic, Sludge handling and removal	2
4.3	Nitrification and De-nitrification Processes	2
4.4	Phosphorous removal, Wastewater disinfection	2
5	**Adsorption and oxidation process**	
5.1	Chemical process –adsorption-theory of adsorption	2
5.2	Ion exchange process-Chemical oxidation	2
5.3	Advanced oxidation process-miscellaneous treatment process	2
	Total lecture hours	**35**

BTL411	REACTION ENGINEERING AND PROCESS CONTROL LAB	CATEGORY	L	T	P	CREDIT
		PCC	0	0	3	2

Preamble:
Practical hands-on training on the operation of key equipment in Reaction Engineering and Process Control.

Prerequisite:
BTT202 and BTT306

Course Outcomes:
After the completion of the course the student will be able to

CO1	Use the basic principles of Chemical Reaction Engineering and Process Control to find kinetics of Chemical reaction and responses of process control systems by performing experiments
CO2	Design experiments and interpret data collected from experimental investigations
CO3	Use modern computing tools necessary for analysis of the experimental data
CO4	Practice ethical approaches in experimental investigation, collection and reporting of data and adhering to the safety ethics set by the laboratory.
CO5	Practice work in diverse groups and perform laboratory experiments.
CO6	Communicate through oral and writing skills through viva and preparing reports of experimental work.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2		2		2								
CO3					2							
CO4								2				
CO5									2			
CO6										2		

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	75	75	4 hours

Continuous Internal Evaluation Pattern:
Attendance : 15 marks
Continuous Assessment : 30 marks
Internal Test (Immediately before the second series test) : 30 marks

End Semester Examination Pattern:
The following guidelines should be followed regarding award of marks

(a) Preliminary work : 15 Marks
(b) Implementing the work/Conducting the experiment : 10 Marks
(c) Performance, result and inference (usage of equipments and troubleshooting) : 25 Marks
(d) Viva voice : 20 marks
(e) Record : 5 Marks

General instructions:
Practical examination to be conducted immediately after the second series test covering the entire syllabus given below. Evaluation is a serious process that is to be conducted under the equal responsibility of both the internal and external examiners. The number of candidates evaluated per day should not exceed 20. Students shall be allowed for the University examination only on submitting the duly certified record. The external examiner shall endorse the record.

Course Level Assessment :
Course Outcomes may be evaluated by either rubrics or any other suitable methods deviced by the faculty members. The criteria for evaluation may be selected as

Course Outcome 1 (CO1):
1. Understanding the objectives
2. Identification of principles
3. Use of principles

Course Outcome 2 (CO2)
1. Experimental Design
2. Analysis of Results: Data, figures, graphs, tables, etc
3. Data interpretation and discussion

Course Outcome 3(CO3):
1. Use of MATLAB tool / MS-Excel
2. Use of any suitable numerical method for fitting of curve for the analysis of experimental data

Course Outcome 4 (CO4):
1. Experimental investigation and data reporting
2. Following the Laboratory safety rules

Course Outcome 5 (CO5):
1. Individual Contributions as a member of group
2. Focus on the task
3. Working with others

Course Outcome 6 (CO6):
1. Knowledge of student (For Viva)
2. Content in report
3. Format and Aesthetics

Model Question Paper- 30 marks
Find the kinetics of the saponification reaction in an Isothermal Batch Reactor by conducting a suitable experiment at 50^0C and 70^0C.

Determine the step response of a two tank non interacting system by conducting a suitable experiment in the experimental setup available in the laboratory and determine the time constants of both tanks.

Syllabus

Experiments/ Exercises 12 experiments are mandatory - Minimum of 4 experiments from Part A, Minimum 4 experiments from part B and minimum 4 experiments from Part C

Part A

1. Kinetic studies in an isothermal batch reactor
2. Kinetic studies in an isothermal semi-batch reactor
3. Kinetic studies a continuous stirred tank reactor
4. Kinetic in an isothermal tubular reactor
5. Kinetic in a plug flow reactor
6. Kinetic studies in a packed bed reactor
7. RTD studies in CSTR
8. RTD studies in PFR
9. Determination of activation energy in an isothermal batch reactor
10. Determination of activation energy in an isothermal semi-batch reactor

Part B

11. Study of dynamic response in a single tank level control system
12. Study of dynamic response in two tanks non-interacting level control system
13. Study of dynamic response in two tanks interacting level control system
14. Study of pneumatic valve characteristics
15. Dynamic response of industrial thermometer with well
16. Dynamic response of industrial thermometer without well
17. Dynamic response of a U tube manometer
18. Temperature Control Trainer
19. PID controller trainer

Part C – Response studies using MATLAB

20. Step Response of first Order System
21. Step Response of First order system with dead time
22. Step response of second order system (for under damped, over damped and critically damped systems)
23. Generating BODE plot, ROOT LOCUS diagrams using MATLAB
24. Servo and regulatory responses of first order systems using P/PI/PID controlleres

Text Books

1. Octave Levenspiel, Chemical Reaction Engineering, 3/e, Wiley Student Education, 2006.
2. Coughanowr R D, LeBlanc E S, Process Systems Analysis and Control, McGraw Hill International Edition.

Reference Books

1. H Scott Fogler, Essentials of Chemical Reaction Engineering, Pearson Education, 2011.
2. Hill C G, Root T W, Introduction to Chemical Engineering Kinetics & Reactor Design, John Wiley, 2014.
3. Stephanopoulose G, Chemical Process Control: An Introduction to Theory and Practice, Prentice Hall of India, New Delhi, 1993.

4. Peter Harriot, Process Control, Tata McGraw Hill, 1972
5. Seborg D E, Edgar TF, Mellichamp D A, Doyle FJ, Process Dynamics and Control,3/e, John Wiley& Sons, 2010.

Course Contents and Lecture Schedule (36 HOURS)

No	Topic	No of lectures
1	Kinetic studies in an isothermal batch reactor	
2	Kinetic studies in an isothermal semi-batch reactor	
3	Kinetic studies a continuous stirred tank reactor	12
4	Kinetic in an isothermal tubular reactor	
5	Kinetic in a plug flow reactor	
6	Kinetic studies in a packed bed reactor	
7	RTD studies in CSTR	
8	RTD studies in PFR	
9	Determination of activation energy in an isothermal batch reactor	
10	Determination of activation energy in an isothermal semi-batch reactor	
11	Study of dynamic response in a single tank level control system	
12	Study of dynamic response in two tanks non-interacting level control system	
13	Study of dynamic response in two tanks interacting level control system	
14	Study of pneumatic valve characteristics	
15	Dynamic response of industrial thermometer with well	12
16	Dynamic response of industrial thermometer without well	
17	Dynamic response of a U tube manometer	
18	Temperature Control Trainer	
19	PID controller trainer	
20	Step Response of first Order System Step Response of First order system with dead time Step response of second order system (for under damped, over damped and critically damped systems)	12
21	Generating BODE plot, ROOT LOCUS diagrams using MATLAB Servo and regulatory responses of first order systems using P/PI/PID controllers	

Total practical hours	**36**

BTQ413	SEMINAR	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	2

Preamble: The course 'Seminar' is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.

Course Objectives:

- To do literature survey in a selected area ofstudy.
- To understand an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: **Apply**).
CO2	Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: **Analyze**).
CO3	Prepare a presentation about an academic document (Cognitive knowledge level: **Create**).
CO4	Give a presentation about an academic document (Cognitive knowledge level: **Apply**).
CO5	Prepare a technical report (Cognitive knowledge level: **Create**).

Mapping of course outcomes with program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO1 1	PO12
CO1	2	2	1	1		2	1					3
CO2	3	3	2	3		2	1					3
CO3	3	2			3			1		2		3
CO4	3				2			1		3		3
CO5	3	3	3	3	2	2		2		3		3

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Life long learning

General Guidelines

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.

- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.

- Guide shall provide required input to their students regarding the selection of topic/ paper.

- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.

- A topic/paper relevant to the discipline shall be selected by the student during the semester break.

- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to theIEC.

- The IEC shall approve the selected topic/paper by the second week of the semester.

- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

Evaluation pattern

Total marks: 100, only CIE, minimum required to pass 50

Seminar Guide: 20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

Seminar Coordinator: 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

Presentation: 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

Report: 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).

BTD415	PROJECT PHASE I	CATEGORY	L	T	P	CREDIT
		PWS	0	0	6	2

Preamble:

The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problemsolving.
- To foster innovation in design of products, processes orsystems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs] : After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2

CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO10	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE I

Phase 1 Target

- Literature study/survey of published literature on the assigned topic
- Formulation of objectives
- Formulation of hypothesis/ design/ methodology
- Formulation of work plan and task allocation.
- Block level design documentation
- Seeking project funds from various agencies
- Preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility study
- Preparation of Phase 1 report

Evaluation Guidelines & Rubrics

Total: 100 marks (Minimum required to pass: 50 marks).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by the Evaluation Committee: 20 Marks.
- Final Evaluation by the Evaluation Committee: 30 Marks.
- Project Phase - I Report (By Evaluation Committee): 20 Marks.

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor).

Evaluation by the Guide

The guide/supervisor shall monitor the progress being carried out by the project groups on a regular basis. In case it is found that progress is unsatisfactory it shall be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Topic Selection: innovativeness, social relevance etc. (2)

Problem definition: Identification of the social, environmental and ethical issues of the project problem. (2)

Purpose and need of the project: Detailed and extensive explanation of the purpose and need of the project. (3)

Project Objectives: All objectives of the proposed work are well defined; Steps to be followed to solve the defined problem are clearly specified. (2)

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (3)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (7)

EVALUATION RUBRICS for PROJECT Phase I: Interim Evaluation						
No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-a	Topic identification, selection, formulation of objectives and/or literature survey. (Group assessment) [CO1]	10	The team has failed to come with a relevant topic in time. Needed full assistance to find a topic from the guide. They do not respond to suggestions from the evaluation committee and/or the guide. No literature review was conducted. The team tried to gather easy information without verifying the authenticity. No objectives formed yet.	The team has identified a topic. The originally selected topic lacks substance and needs to be revised. There were suggestions given to improve the relevance and quality of the project topic. Only a few relevant references were consulted/ studied and there is no clear evidence to show the team's understanding on the same. Some objectives identified, but not clear enough.	Good evidence of the group thinking and brainstorming on what they are going to build. The results of the brainstorming are documented and the selection of topic is relevant. The review of related references was good, but there is scope of improvement. Objectives formed with good clarity, however some objectives are not realistic enough.	The group has brainstormed in an excellent manner on what they were going to build. The topic selected is highly relevant, real world problem and is potentially innovative. The group shows extreme interest in the topic and has conducted extensive literature survey in connection with the topic. The team has come up with clear objectives which are feasible.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-b	Project Planning, Scheduling and Resource/ Tasks Identification and allocation. (Group assessment) [CO4]	10	No evidence of planning or scheduling of the project. The students did not plan what they were going to build or plan on what materials / resources to use in the project. The students do not have any idea on the budget required. The team has not yet decided on who does what. No project journal kept.	Some evidence of a primary plan. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no details. Some evidence on task allocation among the team members.	Good evidence of planning done. Materials were listed and thought out, but the plan wasn't quite complete. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is not complete in all respect / detailed. There is better task allocation and individual members understand about their tasks. There is room for improvement.	Excellent evidence of enterprising and extensive project planning. Gantt charts were used to depict detailed project scheduling. A project management/version control tool is used to track the project, which shows familiarity with modern tools. All materials / resources were identified and listed and anticipation of procuring time is done. Detailed budgeting is done. All tasks were identified and incorporated in the schedule. A well-kept project journal shows evidence for all the above, in addition to the interaction with the project guide. Each member knows well about their individual tasks.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
Phase 1 Interim Evaluation Total Marks: 20						

EVALUATION RUBRICS for PROJECT Phase I: Final Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-c	Formulation of Design and/or Methodology and Progress. (Group assessment) [CO1]	5	None of the team members show any evidence of knowledge about the design and the methodology adopted till now/ to be adopted in the later stages. The team has not progressed from the previous stage of evaluation.	The students have some knowledge on the design procedure to be adopted, and the methodologies. However, the team has not made much progress in the design, and yet to catch up with the project plan.	The students are comfortable with design methods adopted, and they have made some progress as per the plan. The methodologies are understood to a large extent.	Shows clear evidence of having a well-defined design methodology and adherence to it. Excellent knowledge in design procedure and its adaptation. Adherence to project plan is commendable.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
1-d	Individual and Teamwork Leadership (Individual assessment) [CO3]	10	The student does not show any interest in the project activities, and is a passive member.	The student show some interest and participates in some of the activities. However, the activities are mostly easy and superficial in nature.	The student shows very good interest in project, and takes up tasks and attempts to complete them. Shows excellent responsibility and team skills. Supports the other members well.	The student takes a leadership position and supports the other team members and leads the project. Shows clear evidence of leadership.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
1-e	Preliminary Analysis/ Modeling / Simulation/ Experiment / Design/ Feasibility study [CO1]	10	The team has not done any preliminary work with respect to the analysis/modeling/ simulation/experiment/design/feasibility study/ algorithm development.	The team has started doing some preliminary work with respect to the project. The students however are not prepared enough for the work and they need to improve a lot.	There is some evidence to show that the team has done good amount of preliminary investigation and design/ analysis/ modeling etc. They can improve further.	Strong evidence for excellent progress in the project. The team has completed the required preliminary work already and are poised to finish the phase I in an excellent manner. They have shown results to prove their progress.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

1-f	Documentatio n and presentation. (Individual & group assessment). [CO6]	5	The team did not document the work at all. The project journal/diary is not presented. The presentation was shallow in content and dull in appearance. The individual student has no idea on the presentation of his/her part.	Some documentation is done, but not extensive. Interaction with the guide is minimal. Presentation include some points of interest, but overall quality needs to be improved. Individual performance to be improved.	Most of the project details were documented well enough. There is scope for improvement. The presentation is satisfactory. Individual performance is good.	The project stages are extensively documented in the report. Professional documentation tools like LaTeX were used to document the progress of the project along with the project journal. The documentation structure is well-planned and can easily grow into the project report. The presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
Total		**30**	**Phase - I Final Evaluation Marks: 30**			

EVALUATION RUBRICS for PROJECT Phase I: Report Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
1-g	Report [CO6]	20	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly Unacknowledged content. Lack of effort in preparation is evident.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report.	Project report shows evidence of systematic documentation. Report is following the standard format and there are only a few issues. Organization of the report is good. Most of references are cited properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows standard styles.
			(0 - 7 Marks)	(8 - 12 Marks)	(13 - 19 Marks)	(20 Marks)
Phase - I Project Report Marks: 20						

S7 MINOR

BTD481	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble:

Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Biotechnology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Continuous Internal Evaluation Pattern:

Sl. No.	Level of Evaluation	Marks
1	Interim evaluation by the committee	**20**
2	Project Guide	**30**
3	Final Seminar evaluation by the committee	**30**
4	The report evaluated by the evaluation committee	**20**
	Total	**100**
	Minimum required to pass	**50**

The evaluation committee comprises a panel of HoD or a senior faculty member, Project coordinator and project supervisor.

S7 HONOURS

BTT495	MOLECULAR MODELING AND SIMULATION	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble:
Introduction to quantum mechanics and molecular mechanics, energy minimization, homology modeling, molecular dynamics and simulation..

Prerequisite:
Basic principles of general chemistry, organic chemistry and inorganic chemistry and mathematics. Knowledge of physical chemistry.

Course Outcomes: After the completion of the course the student will be able to

CO 1	Formulate the basis for and the most important approximations in key molecular computational models.
CO 2	Choose computational model in various chemical problems
CO 3	Apply modern molecular-level software on presented problems
CO 4	Assess computational results critically.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	2	2		2	-	-	-	-	-	-	-
CO 2	-	-	-	2	3	-	-	-	-	-	-	-
CO 3	-	-	-	2	3	-	-	-	-	-	2	-
CO 4	-	-	-	2	2	-	-	-	-	-	2	-

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions(Minimum 3 questions per CO)

Course Outcome 1 (CO1): Formulate the basis for and the most important approximations in key molecular computational models

1. Provide a quantitative definition of binding affinity (i.e., binding strength). What does it mean for one ligand to bind more tightly than another?
2. Molecular docking algorithms have to be fast to screen large libraries of drug candidates. Describe two approximations that make this possible.
3. Briefly describe the fold recognition (threading) and homology (or comparative) modeling methods. In what different situations do you use these two methods?

Course Outcome 2 (CO2): Choose computational model in various chemical problems

1. Compare and contrast the energy functions used for molecular dynamics simulations and those used for *ab initio* protein structure prediction.
2. How would you go about estimating how long it would take to run an MD simulation? What information would you need to consider?
3. How does the conjugate gradient method differ from the steepest descent method?

Course Outcome 3(CO3): Apply modern molecular-level software on presented problems

1. Suppose we have a single molecular dynamics simulation in which the drug candidate binds to the target and stays bound for the remainder of the simulation. Can we accurately estimate the binding affinity from that simulation? Why or why not?
2. Describe one common approximation made by ligand docking methods, and explain why it helps simplify the problem to be solved.
3. Describe two techniques used to reduce computational time for molecular dynamics simulations

Course Outcome 4 (CO4): Assess computational results critically**.**

1. How is temperature controlled in molecular dynamics and Monte Carlo simulations?
2. Describe the three types of scoring functions that are used in molecular docking.
3. Describe two strategies that can be used to assess the accuracy of a molecular docking program.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 495_

Course Name: _ MOLECULAR MODELING AND SIMULATION ________

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	1	What is the difference between the MD and MC approaches?
2.		How does the conjugate gradient method differ from the steepest descent method?
3.		How is temperature controlled in molecular dynamics and Monte Carlo simulations?
4.		Describe two techniques used to reduce computational time for molecular dynamics simulations.
5.		Give several examples of simulations where you would choose one over the other, and explain why.
6.		In molecular dynamics, is it possible to develop an algorithm that accurately predicts the trajectory of all particles at both short and long times? Explain your answer.
7.		In what situations should we use a quantum mechanical calculation?
8.		Write the physiochemical parameters in QSAR.
9.		Describe two strategies that can be used to assess the accuracy of a molecular docking program
10.		Briefly describe how pharmacophore modeling works.

PART B

Answer any one full question from each module. Each carries 14 marks.

11	a)	Describe the terms of a typical molecular mechanics force field. You should write down the equation, explain the variables, and explain with words what they represent.	(7)
	b)	What is the physical significance of Schrodinger wave function? What is a wave function?	(7)
		OR	
12	a)	Briefly describe methods that can be used to include solvent effects in ab initio molecular orbital calculations.	(7)
	b)	What is force field in molecular dynamics? Explain.	(7)
13	a)	Compare and contrast the Monte Carlo and molecular dynamics simulation methods.	(7)

	b)	Two methods that are widely used for the optimization of molecular geometries are the 'Steepest descents' and 'Newton-Raphson' techniques. Without giving detailed mathematical descriptions, briefly outline the advantages and disadvantages of these two techniques.	(7)
		OR	
14	a)	Suppose we have a single molecular dynamics simulation in which the drug candidate binds to the target and stays bound for the remainder of the simulation. Can we accurately estimate the binding affinity from that simulation? Why or why not?	(7)
	b)	Describe two techniques used to reduce computational time for molecular dynamics simulations	(7)
15		Describe all steps involved in setting up a molecular dynamics simulation of a membrane protein with a ligand. You can assume that there is a crystal structure of the protein with the ligand. The purpose of the simulation is to analyze the dynamics of the protein. Try to be as detailed as possible.	(14)
		OR	
16		Explain about the different solvent models in MD simulation.	(14)
17	a	Briefly describe the fold recognition (threading) and homology (or comparative) modeling methods. In what different situations do you use these two methods?	(7)
	b	Describe the steps involved in homology modelling.	(7)
		OR	
18	a)	Explain the role of physiochemical properties in relation to biological activity and drug design.	(7)
	b)	Describe various lead seeking methods in drug design.	(7)
19	a)	Briefly describe the fundamentals of QSAR.	(14)
		OR	
20	a)	Describe the three types of scoring functions that are used in molecular docking and explain its significance.	(7)
	b)	Explain the different approaches used in computer aided drug design	(7)
		****	

Syllabus

Module 1:

Quantum mechanics & concepts in molecular modeling : Introduction – coordinate systems – potential energy surfaces – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation, introduction to computer hardware and software.

Module 2:

Molecular mechanics and energy minimization:Empirical force field models – Bond stretching – angle bending – torsional term –nonbonding interactions – thermodynamics properties using a forcefield – derived and non derived energy minimization method – simplex – sequential univariate method – steepest descent method – conjugate gradient method- Newton-Rapson method.

Module 3:

Molecular Dynamics and Monte Carlo simulation : Introduction – Using single Model – time steps – Multiple steps – Setting up MD – energy conservation in MD Simulation Examples – Monte Carlo – Random number generation – Difference in MD & MC.

Module 4:

Comparative modeling of proteins – comparison of 3D structure – Homology – steps in homology modeling – tools – databases – side chain modeling – loop modeling.

Module 5:

Drug design:General approach to discovery of new drugs - lead discovery – lead modification – physiochemical principles of drug action – drug stereo chemistry –drug action - 3D database search – computer aided drug design – docking - molecular modeling in drug design – structure based drug design – pharmacophores - QSAR.

Text Books:

1, R.Leach - Molecular Modeling Principles and Application, 2nd edition, Longman Publications, 1996
2. D. Baxivanis and Foulette - Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiely Indian Edition, 2001.

Reference Books

1. T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1.1	Coordinate systems	1
1.2	Potential energy surfaces	2
1.3	Introduction to quantum mechanics	1
1.4	Postulates – Schrodinger wave equation	2
1.5	Born-Oppenheimer approximation	2
1.6	Introduction to computer hardware and software.	1
2.1	Empirical force field models	1
2.2	Bond stretching – angle bending – torsional term –nonbonding interactions	3
2.3	Thermodynamics properties using a forcefield –	1
2.4	Derived and non derived energy minimization method	1
2.5	Simplex – sequential univariate method	1
2.6	Steepest descent method – conjugate gradient method	1
2.7	Newton-Rapson method.	1
3.1	Introduction –MD	1
3.2	Using single Model – time steps	1
3.3	Multiple steps	1
3.4	Setting up MD – energy conservation in MD	1
3.5	Simulation Examples	1
3.6	Monte Carlo	1
3.7	Random number generation	1
3.8	Difference in MD & MC	1
4.1	Comparative modeling of proteins – comparison of 3D structure–	1
4.2	Homology – steps in homology modeling	1
4.3	Tools , databases	1
4.4	Side chain modelling	2
4.5	Loop modelling	2
5.1	General approach to discovery of new drugs	1
5.2	Lead discovery	
5.3	Lead modification	1
5.4	Physiochemical principles of drug action	1
5.5	Drug stereo chemistry –drug action	1
5.6	3D database search	1
5.7	Computer aided drug design	1
5.8	Docking	1
5.9	Molecular modeling in drug design	1
5.10	Structure based drug design	1
5.11	Pharmacophores	1
5.12	QSAR	1

BTT 497	BIOPROCESS SAFETY AND HAZARD ASSESSMENT	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble: The role of a safety engineer in a process industry is quite significant. Sustained optimal operation of any process plant should always be counterbalanced by the safety considerations. The present course aims at providing a general overview of various safety considerations in process industries, with emphasis on the biotech industries.

Prerequisite: Basic understanding of undergraduate level course such as Bioprocess calculation.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Demonstrate the necessity for safety.
CO2	Summarize fire and explosion characteristics and its prevention technique.
CO3	Identify the different types of hazards involved in process industry.
CO4	Analyze various Hazard Analysis techniques.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1			1	1					
CO2	3		1			1	1					
CO3	3					1	1					
CO4	3		1			1	1					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course level assessment questions

Course Outcome 1(CO1): Demonstrate the necessity for safety.

1. Discuss any four major industrial accidents happened in the world and its preventive measures.
2. Elaborate the term accident and loss statistics.
3. What are the effects of toxicants on the biological organism?

Course Outcome 2 (CO2): Summarize fire and explosion characteristics and its prevention technique.

1. What is fire triangle?
2. Differentiate fire and explosion.
3. What are the techniques available for preventing fire and explosion?

Course Outcome 3 (CO3): Identify the different types of hazards involved in process industry.

1. What is chemical hazard and what are the precautions has to be taken for eliminating the chemical hazard?
2. Differentiate mechanical hazard and electrical hazard.
3. How did you eliminate noise hazard?

Course Outcome 4 (CO4): Analyze various Hazard Analysis techniques.

1. Discuss on HAZOP and its team members.
2. Distinguish event tree and fault tree analysis.
3. What do you mean by preliminary hazard analysis?

Sample question paper

			Total Pages:
Reg No.:_______________		Name:___________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, ------------------20----

Course Code: BTT 497

Course Name: BIOPROCESS SAFETY AND HAZARD ASSESSMENT

Max. Marks: 100 — Duration: 3 Hours

PART A

		Answer all questions. Each question carries 3 marks	Marks
1.		What is material safety data sheet?	(3)
2.		How did the toxicants enter into the biological organism?	(3)
3.		Differentiate between flash point and fire point. What is the significance of these two in process industries?	(3)
4.		What is dust explosion?	(3)
5.		How did you evaluate the gas release rate?	(3)
6.		Differentiate between hazard and risk.	(3)
7.		Define hazard identification and risk analysis (HIRA).	(3)
8.		Explain the significance of electrical hazards and how it is controlled	(3)
9.		Explain the significance of preliminary hazard analysis.	(3)
10.		What are important step involved in fault tree analysis?	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

		Module 1	
11.	a	Discuss any four major industrial accidents happened in the world and its preventive measures.	(7)
	b	Elaborate industrial hygiene evaluation.	(7)
12.		Enumerate the steps involved in toxicology.	(14)
		Module2	
13.		Describe different types of fires and fire extinguishers.	(14)
14.		Discuss in detail on the classification of explosion.	(14)
		Module 3	
15.	a	Explain how mechanical hazards are controlled.	(7)
	b	Explain in detail about classification of hazards in Chemical Process Industries	(7)
16.		Elaborate different types of chemical hazards and how can be prevented?	(14)
17.	a	Discuss about dense gas dispersion models.	(7)
	b	Write a detailed account on design for safety, maintenance and fault	(7)

		diagnosis.	
18.		Explain disaster management planning.	(14)
Module 5			
19.		Write a detailed not on consequence analysis.	(14)
20.		Elaborate Hazard and Operability Studies performed in industries.	(14)
***			

SYLLABUS

MODULE I: Safety aspects of process plant

Necessity for safety, safety programs, Engineering ethics, Accident and loss statistics, common industrial accidents-causes and preventive measures, Toxicology: The way toxicants enter biological organisms, The way toxicants are eliminated from biological organisms, The effects of toxicants on biological organisms, Methods to prevent or reduce the entry of toxicants into biological organisms, OSHA process safety management, Material Safety Data sheet, Industrial hygiene evaluation-Numerical problems.

MODULE II: Fire and Explosion

The Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, factors affecting on flammability limit, Ignition sources, sprays and mists, Types of fire and fire extinguishers, Explosion: Detonation and Deflagration, Confined Explosions, Blast Damage Resulting from Overpressure, TNT Equivalency, Energy of Chemical Explosions, Vapor Cloud Explosions, Boiling-Liquid Expanding-Vapor Explosions, Concepts to Prevent Fires and Explosions: Inerting, Vacuum Purging, Pressure Purging, Controlling Static Electricity, ventilation, Explosion-Proof Equipment and Instruments, sprinkler system.

MODULE III: Chemical hazards and relief

Chemical hazards: oxidizing material, Flammable and combustible material, corrosive material, radioactive material and biohazard, Mechanical hazard, Electrical hazard, noise hazard, industrial safety guidelines, Failure types and release rate calculation, Emission and dispersion, Dispersion models for dense gas, Plume dispersion, Jet dispersion, Toxic dispersion model, Evaluation of risk contours.

MODULE IV: Accidents and Risk assessment

Definition of accident, Classification of accidents, common sources of accidents, causes of accidents, accident prevention, Risk analysis, steps in risk analysis, Disaster management and planning, Design for safety, maintenance and fault diagnosis.

MODULE V: HAZAN

Hazard: Identification; Hazard evaluation procedures: Safety Review Methods, Process/ System Checklists, Relative Ranking Techniques (Dow & Mond Indices), Preliminary Hazard Analysis (PHA), "What if" Analysis, Hazard and Operability studies (HAZOP), Failure Modes Effects Analysis (FMEA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Cause-Consequence Analysis (CCA), Human Reliability Analysis (HRA).

Text Books

1. **Crowl, D.A and Louvar, J.F,** *Chemical Process Safety: Fundamentals with Applications,* Prentice Hall, Inc.

2. **Frank P. Lees,** *Loss Prevention in Process Industries, Volume I and II,* Butterworth Heinemann, 1980.
3. R.K.Jain & Sunil S Rao, Industrial Safety, Health and Environment Management Systems, Khanna Publishers, Fourth Edition,2000

Reference Books

1. **Pandey, C.G,** *Hazards in Chemical Units: a Study*, Oxford IBH Publishing Co., New Delhi.
2. **Fawcett H.H and Wood W.S,** *Safety and Accident Prevention in Chemical Operation,* 2 Ed, Wiley *Interscience, 1982.*
3. **Raghavan K. V and Khan A A,** *Methodologies in Hazard Identification and Risk Assessment, Manual by CLRI, 1990.*
4. **Marshal V. C,** *Major Chemical Hazards, Ellis Horwood Ltd., Chichester, United Kingdom, 1987.*

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Safety aspects of process plant**	
1.1	Necessity for safety, safety programs	1
1.2	Engineering ethics, Accident and loss statistics	1
1.3	common industrial accidents-causes and preventive measures	2
1.4	Toxicology: The way toxicants enter biological organisms	1
1.5	The way toxicants are eliminated from biological organisms, The effects of toxicants on biological organisms	2
1.6	Methods to prevent or reduce the entry of toxicants into biological organisms	1
1.7	OSHA process safety management, Material Safety Data sheet	1
1.8	Industrial hygiene evaluation-Numerical problems.	1
2	**Fire and Explosion**	
2.1	The Fire Triangle, Distinction between Fires and Explosion	1
2.2	Flammability Characteristics of Liquids and Vapors	1
2.3	Explosions, factors affecting on flammability limit	1
2.4	Ignition sources, sprays and mists, Types of fire and fire extinguishers	1
2.5	Detonation and Deflagration, Confined Explosions, Blast Damage Resulting from Overpressure	1
2.6	TNT Equivalency, Energy of Chemical Explosions, Vapor Cloud Explosions, Boiling-Liquid Expanding-Vapor Explosions	2
2.7	Concepts to Prevent Fires and Explosions: Inerting, Vacuum Purging, Pressure Purging, Controlling Static Electricity, ventilation, Explosion-Proof Equipment and Instruments, sprinkler system.	2
3	**Chemical hazards and relief**	

3.1	Chemical hazards: oxidizing material, Flammable and combustible material, corrosive material, radioactive material and biohazard	2
3.2	Mechanical hazard, Electrical hazard, noise hazard	1
3.3	industrial safety guidelines, Failure types and release rate calculation	1
3.4	Emission and dispersion, Dispersion models for dense gas	2
3.5	Plume dispersion, Jet dispersion	1
3.6	Toxic dispersion model, Evaluation of risk contours.	2
4	**Accidents and Risk assessment**	
4.1	Definition of accident, Classification of accidents	1
4.2	common sources of accidents, causes of accidents, accident prevention	2
4.3	Risk analysis, steps in risk analysis	1
4.4	Disaster management and planning	1
4.5	Design for safety, maintenance and fault diagnosis	2
5	**HAZAN**	
5.1	Hazard: Identification; Hazard evaluation procedures	1
5.2	Safety Review Methods, Process/ System Checklists	1
5.3	Relative Ranking Techniques (Dow & Mond Indices), Preliminary Hazard Analysis (PHA)	1
5.4	"What if" Analysis, Hazard and Operability studies (HAZOP)	2
5.5	Failure Modes Effects Analysis (FMEA), Fault Tree Analysis (FTA)	2
5.6	Event Tree Analysis (ETA), Cause-Consequence Analysis (CCA),	1
5.7	Human Reliability Analysis (HRA)	1

BTT499	DESIGN AND ANALYSIS OF BIOREACTORS	CATEGORY	L	T	P	CREDIT
		VAC	3	1	0	4

Preamble:
This course aims at introducing the state of the arts in bioreactor technology, its broad range of applications and strengthening the knowledge on analysing bioreactor performance

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the functional description and working of conventional and novel bioreactors
CO2	Calculate the batch reaction time and total batch time for enzymatic reactions
CO3	Estimate theoretical design parameters in flow reactors to compare the performance of different types of reactors
CO4	Describe the theoretical and mechanical design aspects of bioreactors.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										
CO2	3	2										
CO3	3	2	2									
CO4			3									

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment(2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B.

Part A contain 10 questions with 2 questions from e ach module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions :

Course Outcome 1 (CO1): Explain the functional description and working of conventional and novel bioreactors

1. Describe on the functional components of a bioreactor?
2. How is hollow fibre modules constructed?
3. What are the benefits of disposable bioreactors?

Course Outcome 2 (CO2): Calculate the batch reaction time and total batch time for enzymatic reactions

A strain of bacteria has been genetically engineered to produce protein. A batch culture is started by inoculating 15 g of cells into 80-litre batch stirred fermenter containing 10 g/l glucose. The culture immediately adapt to the environment so that it can be assumed that the system does not exhibit a lag phase. The cell maintenance requirement can be neglected. Also there are no extra cellular products formed. The maximum specific growth rate of the cells is 1 h^{-1}. The biomass yield from glucose is 0.6 g/g.

1. Obtain the expression for batch growth time of this culture?
2. What will be time taken to reach the substrate concentration to 75% of the initial value?
3. If a downtime of 25 hours is expected between batches, how many batches could be processed in a year?

Course Outcome 3 (CO3): Estimate theoretical design parameters in flow reactors to compare the performance of different types of reactors

A 5 m^3 fermenter is operated continuously using a feed substrate concentration of 20 kg/m^3. The microorganism cultivated in the reactor has the following characteristics: $\mu max = 0.45\ h^{-1}$; $K_S = 0.8$ kg/m^3; $Y_{X/S} = 0.55$ kg/kg.

1. Obtain the residence time of this chemostat?

2. What feed flow rate is required to achieve 90% substrate conversion?
3. How does the biomass productivity at 90% substrate conversion compare with the maximum possible.

Course Outcome 4 (CO4): Describe the theoretical and mechanical design aspects of bioreactors.

1. What are the guidelines to be followed in designing a bioreactor?
2. Explain the tasks served by an agitator?
3. Describe on the stepwise procedure for bioreactor vessel wall design?

Model Question Paper

			Total Pages:
Reg No.:________________			Name:____________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, -------------------20----
Course Code: BTT499
Course Name: DESIGN AND ANALYSIS OF BIOREACTORS

Max. Marks: 100		Duration: 3 Hours

PART A

	Answer all questions. Each question carries 3 marks	Marks
1	Describe on the factors affecting the performance of bioreactors?	(3)
2	List the different types of seals used in bioreactors and their functions?	(3)
3	Write the stepwise procedure for determining the annual productivity in batch culture?	(3)
4	Illustrate how the activity of an enzyme varies with time?	(3)
5	Give any three difference between a Chemostat and Turbidostat?	(3)
6	What you mean by washout of cells?	(3)
7	State Power No and describe its importance in bioreactor design?	(3)
8	What are the different ways by which k_La can be improved?	(3)
9	State any three moments of RTD with the relevant equation describing it?	(3)
10	What are the different ways by which RTD can be characterised?	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11	a) With the help of a neat diagram describe the constructional features of a fluidized bed bioreactor?	(7)

		b) Explain the working any one bioreactor that can be used for the culture of shear sensitive cells?	(7)
	12	With the help of neat labelled diagrams explain the construction and working of different types of air lift reactors. List the advantages, disadvantages and applications of these reactors	(14)
Module 2			
	13	Pseudomonas methylotrophus is used to produce single cell protein from methanol in a 1000 m^3 pressure-cycle airlift fermenter. The biomass yield from substrate is 0.41 g/g , K_S is 0.7 mg/l, and the maximum specific growth rate is 0.44 per hour. The medium contains 4% (w/v) methanol. A substrate conversion of 98% is desirable. The reactor is operated in batch or continuous mode. An inoculum of 0.01% (w/v) is used and the downtime between batches is 20 h. Neglect maintenance requirements. a. Obtain the expression for batch growth time of this culture? b. How many batches could be processed in a year? c. What would be the annual biomass production?	(14)
	14	Aspartase enzyme is used industrially for the manufacture of aspartic acid, a componentof low-calorie sweetener. Fumaric acid ($C_4H_4O_4$) and ammonia are converted to asparticacid ($C_4H_7O_4N$) according to the equation: $C_4H_4O_4 + NH_3 \rightarrow C_4H_7O_4N$ Under investigation is a process using aspartase in intact ***Bacillus cadaveris*** cells. In the substrate range of interest, the conversion can be described using Michaelis_Menten kinetics with Km 54.0 g/l. The substrate solution contains 15% (w/v) ammonium fumarate; enzyme is added in the form of lyophilised cells and the reaction is stopped when 85% of the substrate is converted. At 37^0C, vmax is 8.5 g/(l)(h) and the half-life is to 2.3 days. (a) Calculate the batch reaction time? (b) Calculate the total batch cycle time and the no. of batches if the average downtime between batch reactions is 28 h?	(14)
Module 3			
	15	i) Derive the condition for maximum productivity in a chemostat and illustrate the effect of dilution rate on volumetric productivity? ii) A 5 m^3 stirred fermenter is operated continuously with feed substrate concentration of 20 kg/m^3. The microorganism cultivated in the reactor has the following characteristics: $\mu max=0.45\ h^{-1}$, Ks=0.8g/l, $Y_{X/S}$=0.55g/g Determine the maximum possible biomass productivity at 90% substrate conversion if the maintenance requirements and product formation are negligible?	(8) (6)
	16	i) What are the advantages of ideal plug flow over mixed flow (Batch & CFSTBR)? ii) For an enzymatic reaction taking place inside an ideal Plug Flow Tubular	(6)

		Bioreactor obtain the expression for reactor length and residence time.	(8)
Module 4			
	17	With the help of a neat diagram explain all the functional components of a stirred tank bioreactor	(14)
	18	i) What are the different types of agitator assemblies used in bioreactors? Explain on each. ii) How do you determine the power requirement for ungassed Newtonian fluids in a fermenter?	(6) (8)
Module 5			
	19	i) What are the non-idealities observed in a batch bioreactor? ii) Explain the procedure of conducting RTD analysis? How does RTD analysis help in identifying the ills in a bioreactor?	(7) (7)
	20	i) Draw the schematic representation of a PFTBR with recycle and give the balance equations in terms of substrate and cell concentrations. ii) Explain how N no of equal volume CFSTBRs can be used to model a non-ideal tubular reactor? Substantiate your answer with mathematical derivation.	(5) (9)

Syllabus

Module 1: Bioreactors - Function, description, working, advantages and limitations

Conventional Bioreactors - Stirred tank, airlift, airlift pressure cycle bioreactor, packed bed, fluidized bed, trickle bed and flocculated cell bioreactors.

Novel Bioreactors - inverse fluid flow units, hollow fibre reactors, centrifugal field reactors, rotating drum bioreactor, spin filter bioreactor, disposable culture systems and wave bioreactor.

Module 2: Batch Bioreactors

Batch bioreactor, cell death in batch reactor, endogenous metabolism, maintenance, calculation of batch reaction time from ideal system for enzyme reaction and cell culture, batch reaction time with enzyme deactivation, calculation of total batch time.

Module 3: Continuous Flow Bioreactors

Ideal continuous flow stirred tank bioreactor(CFSTBR) - chemostat, multiple steady state analysis, steady state concentrations in a chemostat, substrate conversion and biomass productivity, mean residence time, comparison of batch bioreactor and single stage CFSTBR, washout condition, stability of the chemostat, chemostat with cell recycle, comparison of steady-state biomass concentration and volumetric biomass productivity for a chemostat with and without cell recycle, numerical problems on conversion and productivity.

Plug flow tubular reactor (PFTR), comparison of ideal mixed flow (batch and CFSTBR) and plug flow tubular reactors, calculation of reactor length and residence time, recycling in PFTRs, analysis of recycle reactors

Module 4: Design aspects of bioreactors

Guidelines for bioreactor design, bioreactor geometry, bioreactor vessels, agitator assembly, rheology and mixing, design, operation and types of agitators, power requirements for agitation, effects of agitation on mass transfer, oxygen delivery system - spargers, foam control system, mass transfer between phases – factors affecting mass transfer between phases

Module 5: Concept of non-ideal reactors

Residence time distribution, E(t) or F(t) and the bioreactor design, models of non-ideal reactors - Plug flow tubular reactor (PFTR), comparison of ideal mixed flow (batch and CFSTBR) and plug flow tubular reactors, calculation of reactor length and residence time, recycling in PFTRs, analysis of recycle reactors

Text Books

1. Pauline M Doran, Bioprocess Engineering Principles, Academic Press, 2013.
2. D G Rao, Introduction to Biochemical Engineering, Tata McGraw Hill, 2006.
3. Tapobrata Panda, Bioreactors: Analysis and Design, Tata McGraw-Hill Education, 2011.

Reference Books

1. Alan H Scragg, Bioreactors in Biotechnology - A Practical Approach, Ellis Horwood, 1991.
2. Klaas van't Riet, Johannes Tramper, Basic Bioreactor Design, Marcel Dekker, 1991.
3. Douglas S Clark, Harvey W Blanch, Biochemical Engineering, 2/e, Marcel Dekker, 1997.
4. J E Bailey, D F Ollis, Biochemical Engineering Fundamentals, 2/e, McGraw-Hill ChemicalEngineering Series, 1986.
5. Octave Levenspiel, Chemical Reaction Engineering, 3/e, Wiley Student Education, 2006.
6. H Scott Fogler, Essentials of Chemical Reaction Engineering, Pearson Education, 2011.

Course Contents and Lecture Schedule (50 HOURS)

No	**Topic**	**No of lectures**
1	Conventional Bioreactors - Stirred tank bioreactors - Functional components	1
2	Airlift, airlift pressure cycle bioreactor	1
3	Packed bed, fluidized bed, trickle bed bioreactors.	1
4	Flocculated cell bioreactors.	1
5	Novel Bioreactors - inverse fluid flow units	1
6	Hollow fibre reactors, centrifugal field reactors	1
7	Rotating drum bioreactor, spin filter bioreactor	1
8	Disposable culture systems and wave bioreactor.	1
9	Batch reactor, Kinetics of cell growth, substrate utilization and product formation	2
10	Cell death in batch reactor, endogenous metabolism, maintenance	1
11	Calculation of batch reaction time from ideal system for enzyme reaction and cell culture	1
12	Batch reaction time with enzyme deactivation	1
13	Components of total batch time, Calculation of total batch time.	1
14	Numerical problems	2

15	Ideal continuous flow stirred tank bioreactor(CFSTBR) – chemostat - steady state concentrations of substrate and biomass in a chemostat	2
16	Multiple steady state analysis, mean residence time, Biomass productivity, maximum biomass productivity	2
17	Comparison of batch bioreactor and single stage CFSTBR	1
18	Washout condition, stability of the chemostat, Numerical problems	2
19	Chemostat with cell recycle, comparison of steady-state biomass concentration and volumetric biomass productivity for a chemostat with and without cell recycle	1
20	Numerical problems on conversion and productivity.	2
21	Plug flow tubular reactor (PFTR) - Calculation of reactor length and residence time	2
22	Comparison of ideal mixed flow (batch and CFSTBR) and plug flow tubular reactors	1
23	Recycling in PFTRs, Analysis of recycle reactors	1
24	Guidelines for bioreactor design, bioreactor geometry, bioreactor vessels	1
25	Rheology and mixing, design, operation and types of agitators, power requirements for agitation	2
26	Effects of agitation on mass transfer, oxygen delivery system – spargers, Foam control system	1
27	Mass transfer between phases – factors affecting mass transfer between phases	2
28	Non-ideality in reactors, Non-ideality in batch bioreactors, Residence time distribution, E(t) or F(t) and the bioreactor design	2
29	Models of non-ideal reactors –Tanks in Series Model and Dispersion Model	2
30	Comparison of ideal mixed flow (batch and CFSTBR) and plug flow tubular reactors- residence time	1
31	Recycling in PFTBR, Analysis of recycle reactors	1
32	Numerical problems	3
	Total lecture hours	**45**

SEMESTER VIII

BTT402	ENVIRONMENTAL BIOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: Apply biotechnological know-hows in tackling environmental problems

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Articulate the role of microorganisms in preventing and abating environmental pollution.
CO 2	Identify and analyze the common pathways in removal and detoxification of pollutants.
CO 3	Construct important energy reactions in waste degradation.
CO 4	Identify the source of BOD in wastewater and its determination and also set up different types of biofilm processes.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	2	-	3	3	-	-	-	-	2
CO2	-	-	-	2	-	3	3	-	-	-	-	2
CO3	-	-	-	2	-	3	3	-	-	-	-	2
CO4	-	-	-	2	-	3	3	-	-	-	-	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Articulate the role of microorganisms in preventing and abating environmental pollution.

1. Explain any two methods commonly employed for detection of indicator microorganisms.
2. Explain electron transport system and oxidative phosphorylation.

Course Outcome 2 (CO2): Identify and analyze the common pathways in removal and detoxification of pollutants.

1. Explain the general characteristics and functions of proteins and lipids relevant to environmental biotechnology.
2. Explain any two metabolic pathways relevant to environmental biotechnology. Mention their importance.

Course Outcome 3(CO3): Construct important energy reactions in waste degradation.

1. Explain substrate partitioning and cellular yield in association with bacterial energetics.
2. Illustrate energy reactions of methanogenesis and ethanol fermentation. Write the relevant equations.

Course Outcome 4 (CO4): Identify the source of BOD in wastewater and its determination and also set up different types of biofilm processes.

1. Give the conditions at which conventional BOD test is performed? Mention the importance of seeding in a BOD test.
2. Explain the mechanism of detoxification of hazardous chemicals by dehalogenation. Explain with an example.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION_20__

Course Code: BTT402

Course Name: ENVIRONMENTAL BIOTECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions. Each question carries 3 marks	Marks
1.		Classify bacteria based on their carbon and energy source? Give examples.	(3)
2.		Describe the role and characteristics of proteins and nucleic acids present in the microorganisms.	(3)
3.		Explain ethanol fermentation and sulphate reduction reaction with equation.	(3)
4.		Define NBOD and theoretical oxygen demand?	(3)
5.		Explain the role of fungi in environmental biotechnology	(3)
6.		How can we relate stoichiometry and empirical formula with bacterial energetics?	(3)
7.		Write a note on microbial mat and suspended growth systems	(3)
8.		Explain the relevance of methanogens in environmental biotechnology? Give examples.	(3)
9.		Explain biotransformation of metals with examples.	(3)
10.		Explain the term bioaugmentation	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11.		List out some indicator microorganisms and mention the diseases caused by them. Explain any one method commonly employed for detection of indicator microorganisms.	(14)
12.		Functional diversity of microbes plays a significant role in the environment. Justify.	(14)

Module 2

13.		What is fermentation? Explain the half reaction of simple fermentation process.	(14)
14.		Illustrate energy reactions of methanogenesis and ethanol fermentation. Write the relevant equations.	(14)

Module 3

15.		Explain electron transport system and oxidative phosphorylation.	(14)

16.		Explain any two metabolic pathways relevant to environmental biotechnology. Mention their importance.	(14)
Module 4			
17.		Describe the working principle of rotating biological contactors with a schematic diagram.	(14)
18.		Explain biofilm kinetics associated with substrate phenomenon.	(14)
Module 5			
19.		Explain the mechanism of detoxification of hazardous chemicals by dehalogenation. Explain with an example.	(14)
20.		Explain the different genetic modifications used in removal and detoxification of hazardous chemicals.	(14)
***			

Syllabus

Module 1: Microbes and Environment

Microbes-eukaryotes, prokaryotes, viruses and their role in environmental biotechnology, reproduction and growth, energy and carbon-source classes of bacteria, environmental conditions for growth, other multicellular organisms relevant to environmental biotechnology, functional diversity of microbes in natural environment, indicator microorganisms, detection of indicator microorganisms

Module 2: Biochemical pathways in Environment

Metabolism-description of biological macromolecules-lipids carbohydrates, nucleic acids and proteins, metabolic pathways with particular relevance to environmental biotechnology, fermentation and respiration, electron and energy carriers, electron transport systems and oxidative phosphorylation.

Module 3: Stoichiometry and bacterial energetics

Stoichiometry and bacterial energetics-empirical formula for cells, substrate partitioning and cellular yield, important energy reaction-aerobic oxidation, denitrification, sulphate reduction, methanogenesis and ethanol fermentation, simple fermentation reactions, overall reactions for biological growth.

Module 4: Oxygen demand and Aerobic biofilm processes

Oxygen demand: Biochemical, Chemical, and Theoretical, oxygen demand, carbonaceous biochemical oxygen demand (CBOD), and nitrogenous BOD (NBOD), BOD curve, sources of BOD, Theoretical Oxygen Demand, BOD removal kinetics, CBOD rate coefficient, BOD measurement, application, and limitations, BOD Test: limitations and alternatives, seeding, dissolved oxygen sag curve, Numerical problems on BOD.

Aerobic biofilm processes: Basic principle, classification of biofilm processes, formation, structure and behavior of biofilms, oxygen transport in biofilms, biofilm kinetics, fixed bed reactors, expanded bed reactors- fluidized-bed and circulating-bed biofilm reactors, advantages of biofilm reactors, hybrid biofilms/suspended growth systems, microbial mats.

Module 5: Bioremediation

Detoxification of hazardous chemicals- Degradation of highly concentrated toxic pollutants: Halogenated, Non halogenated & petroleum hydrocarbons, Mechanisms of detoxification-oxidation, dehalogenation, biotransformation of metals, use of genetically engineered organisms in removal and detoxification of hazardous chemicals, advantages and constrains in the use of genetically engineered organisms. Case studies on bioremediation of halogenated and non- halogenated petroleum hydrocarbons.

Text Books

1. Bruce E Rittmann, Perry L McCarty, *Environmental Biotechnology: Principles and applications*, McGraw-Hill, 2001.
2. Alan Scragg, *Environmental Biotechnology*, Oxford University Press, 2005.
3. Gareth M Evans, Judith C Furlong, *Environmental Biotechnology-Theory and Applications*, John Wiley & Sons, 2003.

Reference Books

1. T Srinivas, *Environmental Biotechnology*, New Age International.
2. P R Yadav, Rajiv Tyagi, Environmental Biotechnology, Discovery Publishing, House, 2006.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Microbes and Environment**	
1.1	Microbes-eukaryotes, prokaryotes, viruses and their role in environmental biotechnology, reproduction and growth	1
1.2	Energy and carbon source, classes of bacteria, environmental conditions for growth	1
1.3	Other multicellular organisms relevant to environmental biotechnology, functional diversity of microbes in natural environment	1
1.4	Indicator microorganisms, detection of indicator microorganisms	1
2	**Biochemical pathways in Environment**	
2.1	Metabolism-description of biological macromolecules-lipids carbohydrates, nucleic acids and proteins	2
2.2	Metabolic pathways with particular relevance to environmental biotechnology	2
2.3	Fermentation and respiration	1
2.4	Electron and energy carriers, electron transport systems and oxidative phosphorylation	2
3	**Stoichiometry and bacterial energetics**	
3.1	Stoichiometry and bacterial energetics-empirical formula for cells	2
3.2	Substrate partitioning and cellular yield	2
3.3	Important energy reaction-aerobic oxidation, denitrification, sulphate reduction, methanogenesis and ethanol fermentation, simple fermentation reactions,	2

3.4	Overall reactions for biological growth.	1
4	**Oxygen demand and Aerobic biofilm processes**	
4.1	**Oxygen demand**: Biochemical, Chemical, and Theoretical, oxygen demand, carbonaceous biochemical oxygen demand (CBOD), and nitrogenous BOD (NBOD), BOD curve, sources of BOD, Theoretical Oxygen Demand	2
4.2	BOD removal kinetics, CBOD rate coefficient, BOD measurement, application, and limitations, BOD Test: limitations and alternatives, seeding, dissolved oxygen sag curve.	2
4.3	Numerical problems on BOD	1
4.4	**Aerobic biofilm processes:** Basic principle, classification of biofilm processes, formation, structure and behaviour of biofilms,	1
4.5	Oxygen transport in biofilms, biofilm kinetics, fixed bed reactors,	2
	Expanded bed reactors- fluidized-bed and circulating-bed biofilm reactors, advantages of biofilm reactors	1
4.6	Hybrid biofilms/suspended growth systems, microbial mats.	1
5	**Bioremediation**	
5.1	Detoxification of hazardous chemicals- Degradation of highly concentrated toxic pollutants: Halogenated, Non halogenated & petroleum hydrocarbons.	2
5.2	Mechanisms of detoxification- oxidation, dehalogenation, biotransformation of metals,	1
5.3	Use of genetically engineered organisms in removal and detoxification of hazardous chemicals, advantages and constraints in the use of genetically engineered organisms.	2
5.4	Case studies on bioremediation of halogenated and non-halogenated petroleum hydrocarbons	2
	Total lecture hours	**35**

PROGRAM ELECTIVE III

BTT414	FOOD PROCESS TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: The objective of this course is to familiarise the properties of food and different unit operations carried out in food industries. This course gives an overview of food spoilage and ways to enhance shelf life of food. It also emphasize the emerging technologies for food processing.

Prerequisite: Basic understanding of undergraduate level courses such as Mass transfer, Heat Transfer and Microbiology.

Course Outcomes: After the completion of the course, the student will be able to

CO1	Understand the different physicochemical properties of food.
CO2	Analyze the theory and application of unit operations in food processing
CO3	Describe microbial food spoilage and factors involved.
CO4	Demonstrate various food processing and preservation techniques and the equipments used.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	3	2	2	1	2							
CO3	1	2	2			2						
CO4	2	2	2	1	2							2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course level assessment questions

Course Outcome 1(CO1): To understand the different physicochemical properties of food.

1. Summarize the biochemical properties of food?
2. Explain the physical attributes of food?
3. How can you estimate the colour and flavour in foods?

Course Outcome 2 (CO2): To analyze the theory and application of unit operations in food processing.

1. What are the application of mass transfer in food industry?
2. List the different types of dryers.
3. What are the commonly employed separation processes?

Course Outcome 3 (CO3): To describe microbial food spoilage and factors involved.

1. What are the sources of microorganisms associated with food? Explain.
2. Explain the various extrinsic factors which affects the growth and survival of microorganism in food.
3. What do you understand by poising capacity of a food with respect to oxidation reduction potential?

Course Outcome 4 (CO4): To demonstrate various food processing and preservation techniques and the equipments used.

1. Explain how continuous flow sterilization can be applied in food preservation and how it affects food quality.
2. Explain any two thermal food preservation techniques with principle.
3. What does the term “high pressure processing” mean? What is the working principle of HPP?

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH/EIGHTH SEMESTER B. TECH DEGREE EXAMINATION 20____

Course Code: BTT414

Course Name: FOOD PROCESS TECHNOLOGY

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.		How does thermal conductivity and diffusivity affect the physical properties of food?
2.		Highlight the importance of aspect ratio and sphericity in considering the shape of food.
3.		Summarize the major size reduction mechanism adopted in food process industries.
4.		Comment on the effect of mixing operation on the various properties of food.
5.		Define pasteurization. Explain the importance of pasteurization in food industry.
6.		Illustrate the principle of freeze drying in food preservation.
7.		Explain the Limulus lysate test for detecting the presence of Endotoxins in food.
8.		Define any two methods to detect the presence of microorganisms in food.
9.		What does the term “high pressure processing” mean?
10.		Differentiate between pasteurization and sterilization.

PART B

Answer any one full question from each module. Each carries 14 marks.

		Module 1	
11.	a)	Summarize the thermal properties of food materials.	(4)
	b)	Discuss in detail about the different physical attributes of food with its measurement method.	(10)
		OR	
12.	a)	Explain the role of vitamins in nutritional quality.	(8)
	b)	Discuss the biochemical properties of food.	(6)
		Module 2	
13.	a)	What is the role of mixing in food processing? Explain the working of an equipment used for homogeneous mixing in food industry.	(7)
	b)	Describe the fluid flow theory and applications as related to food	(7)

		processing	
		OR	
14.	a)	Differentiate between single and multiple effect evaporation.	(6)
	b)	Briefly explain the different separation operations used in food Process Industries.	(8)
		Module 3	
15.	a)	Compare the working of plate freezer and blast freezer.	(8)
	b)	Diagrammatically explain the working of a fluidized bed drier.	(6)
		OR	
16.	a)	Define crystallisation. Explain the working of a crystallizer used in food processing.	(7)
	b)	Illustrate the principle and working of an extraction equipment used in food industry.	(7)
		Module 4	
17.	a)	Describe the various chemical changes brought about by microorganisms in carbohydrate compounds.	(7)
	b)	Explain the role of bacteria in food spoilage. How do u identify a food spoiled by bacteria?	(7)
		OR	
18.	a)	What is shelf life? Explain the methods for testing the shelf life of food.	(7)
	b)	How do intrinsic parameters affect the growth and survival of microorganisms in food?	(7)
		Module 5	
19.	a)	With a neat flow chart explain the working principle of osmotic dehydration. What are the factors affecting osmotic dehydration?	(7)
	b)	With a neat diagram explain the principle of pulsed electric field processing.	(7)
		OR	
20.	a)	Elaborate the low temperature preservation techniques of food.	(7)
	b)	Compare the thermal and non-thermal methods of food preservation.	(7)
****			

SYLLABUS

Module 1: Properties of food

Properties of foods-size, shape, volume and related physical attributes, Rheological properties, Thermal properties, Electromagnetic properties, Biochemical properties, Sensory characteristics, main components in food, Nutritional quality. Measurement of colour, flavour, consistency, viscosity, texture and their relationship with food quality and composition.

Module 2: Unit operations in food processing

Unit operations in food processing - Fluid flow theory and applications, Heat transfer theory and applications, Drying, Evaporation, Contact equilibrium separation processes: theory and applications, Mechanical separations-Size reduction and classification. Mixing, grading and sizing of food

Module 3: Equipment used in food processing

Equipment used in food processing (Theory and applications): pasteurizer, homogenizer, evaporators and concentrators, different types of freezers including plate freezers, blast freezer, cryogenic freezer, vacuum freezer. Various types of driers, including trays drier, spray drier, fluidized bed drier, freeze drier, solar drier. Equipments for Extraction, filtration, centrifugation and crystallisation. Extruders and Emulsifiers.

Module 4: Food Spoilage

Food spoilage, microorganisms causing foods spoilage, factors affecting the growth and survival of microorganisms in food, chemical changes of foods caused by microorganisms, shelf life, determination of the presence of microorganisms and / or their products in Foods by various techniques.

Module 5: Food processing and preservation

Food preservation processes-Water Activity and Food Preservation, Food preservation techniques using heat: Pasteurization, Blanching, Continuous flow sterilization and UHT processing. Low temperature preservation: Freezing, Thawing, vacuum cooling and High pressure freezing. Emerging technologies for food processing: High-Pressure Processing, Food Irradiation, Pulsed electric field processing, Infrared heating, Non-thermal processing by radio frequency electric fields, Osmotic dehydration, Application of ultrasound and irradiation, Ohmic heating, Microwave heating.

Text Books

1. P J Fellows, *Food Processing Technology: Principles and Practice*, 3/e, CRC Press, 2009.
2. B Sivasankar, *Food Processing and Preservation*, PHI Learning Pvt. Ltd., 2009.

Reference Books

1. Rao D G, *Fundamentals of Food Engineering*, PHI Learning Private Ltd., 2010.
2. R Paul Singh, Dennis R Heldman, *Introduction to Food Engineering*, 4/e, Elsevier, 2009.
3. Da-Wen Sun, *Emerging Technologies for Food Processing*, Elsevier, 2014.
4. PG Smith, *Introduction to Food Process Engineering*, 2/e, Springer, 2011.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Properties of food**	
1.1	Properties of foods-size, shape, volume and related physical attributes	1
1.2	Rheological properties, Thermal properties, Electromagnetic properties, Biochemical properties, Sensory characteristics	1
1.3	Main components in food	1
1.4	Nutritional quality	2
1.5	Measurement of colour, flavour, consistency, Viscosity, texture and their relationship with food quality and composition.	1
2	**Unit operations in food processing**	
2.1	Unit operations in food processing - Fluid flow theory and applications, Heat transfer theory and applications.	2
2.2	Drying, Evaporation, Contact equilibrium separation processes: theory and applications,	2
2.3	Mechanical separations-Size reduction and classification.	2
2.4	Mixing	1
2.5	Grading and sizing of food.	1
3	**Equipments used in food processing**	
3.1	Equipments used in food processing (Theory and applications): pasteurizer, homogenizer, evaporators and concentrators.	1
3.2	Different types of freezers including plate freezers, blast freezer, cryogenic freezer, vacuum freezer.	1
3.3	Various types of driers, including trays drier, spray drier, fluidized bed drier, freeze drier, solar drier.	1
3.4	Equipments for Extraction, filtration, centrifugation and crystallisation.	2
3.5	Extruders and Emulsifiers	1
4	**Food Spoilage**	
4.1	Food spoilage, microorganisms causing foods spoilage.	2
4.2	Factors affecting the growth and survival of microorganisms in food.	1
4.3	Chemical changes of foods caused by microorganisms	1
4.4	Shelf life, determination of the presence of microorganisms and / or	2

	their products in Foods by various techniques	
5	**Food processing and preservation**	
5.1	Food preservation processes-Water Activity and Food Preservation.	1
5.2	Food preservation techniques using heat: Pasteurization, Blanching, Continuous flow sterilization and UHT processing.	2
5.3	Low temperature preservation: Freezing, Thawing, vacuum cooling and High pressure freezing.	2
5.4	Emerging technologies for food processing: High-Pressure Processing, Food Irradiation, Pulsed electric field processing, Infrared heating.	2
5.5	Non-thermal processing by radio frequency electric fields, Osmotic dehydration, Application of ultrasound and irradiation, Ohmic heating, Microwave heating.	2
	Total lecture hours	**35**

BTT 424	Biorefinery Engineering	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: To provide an overview of the different types of renewable feed stock and the basic knowledge required to convert them into fuels, power, heat, and value-added chemicals

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the need for biorefinery, principles and environmental aspects
CO2	Identify the most common sources of raw materials and their characteristics.
CO3	Describe the salient features of different types of biorefineries.
CO4	Explain biomass conversion processes.
CO5	Explain CO2 capture using algae and its conversion to fuels and chemicals.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2						2					
CO2	2											
CO3	2						2					
CO4	2						2					
CO5	2						2					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Marks distribution:

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 subdivisions and carry 14marks.

Course Level Assessment Questions:

Course Outcome 1 (CO1): Explain the need for biorefinery, principles and environmental aspects

1. Biorefinery principles and environmental aspects
2. Biorefinery products
3. Policy issues, Indian Biofuel Programme

Course Outcome 2 (CO2): Identify the most common sources of raw materials and their characteristics

1. Biorefinery feedstock types
2. Cost, availability and pre-treatment of feedstocks

Course Outcome 3 (CO3): Describe the salient features of different types of biorefineries

1. Biorefinery types
2. SWOT and life cycle analysis of biorefineries

Course Outcome 4 (CO4): Explain biomass conversion processes

1. Biochemical conversion methods
2. Thermochemical processing of biomass

Course Outcome 5 (CO5): Explain CO2 capture using algae and its conversion to fuels and chemicals

1. Basic principles of algal biorefineries
2. Life cycle assessment and economic analysis of algal biorefineries

Model Question Paper

			Total Pages:
Reg No.:		**Name:**	
		APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY _________SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__	
		COURSE CODE: BTT424	
		COURSE NAME: BIOREFINERY ENGINEERING	
Time: 3 hrs			**Total Marks:100**
		PART A	
		Answer all questions. Each question carries 3 marks.	
1.	a	Comment on the environmental aspects of biorefineries.	3
2.	b	Categorize common biorefinery products with suitable examples.	3
3.	c	Illustrate the common pretreatment methods for biomass.	3
4.	d	Elaborate on energy crops with examples.	3
5.	e	Explain life cycle analysis in the context of biorefineries.	3
6.	f	Illustrate syngas platform biorefineries.	3
7.	g	Give examples for chemicals obtained through thermochemical processing of biomass.	3
8.	h	Discuss the role of lignin-degrading enzymes in biochemical conversion processes.	3
9.	i	Explain the environmental implications of algal biorefineries.	3
10.	j	Explain carbon dioxide capture using algae.	3
		PART B	
		Answer any one full question from each module. Each question carries 14 marks.	
11.		Outline the various policy issues in biorefineries.	14
		OR	
12.		Elaborate on the Indian Biofuel programme.	14
13.		Explain the use of lignocellulosic biomass as feedstock in biorefinery	14
		OR	
14.		Comment on the cost and availability aspects of biorefinery feedstocks, with emphasis on the latest trends.	14
15.		Illustrate C6 platform biorefineries.	14
		OR	
16.		Explain SWOT analysis in biorefineries, with a suitable example.	14
17.		Explain the production of lactic acid along with its properties and uses.	14
		OR	
18.		Explain the thermochemical processing of Bio-oil into fuels	14
19.		Explain the different cultivation systems for algae. Append neat sketches.	14
		OR	
20.		Discuss the process for production of biodiesel from algae.	14

Syllabus:

Fundamentals, environmental aspects, biorefinery processes and products, feedstocks and their characteristics, biochemical and thermochemical processing to obtain fuels and other chemicals, CO2 capture using algae and its conversion to fuels and chemicals, Life Cycle Assessment

Module 1:Fundamentals of Biorefinery- Need for biorefinery, biorefinery principles, environmental aspects of biorefineries, Biorefinery products - biofuels such as ethanol, biodiesel, butanol, hydrogen, and biogas, biochemicals, and biopolymers, specialty chemicals and food ingredients, building block chemicals, Policy issues in biofuels, Indian biofuel programme,

Module 2:Biorefinery feedstocks and their characteristics - sugars, starch, oil, microalgae, energy crops - corn, soybeans, and sugarcane. Lignocellulosic biomass - wood, wood wastes and forestery residues, Lignocellulosic energy crops - *Miscanthus* spp. and various grasses, jatropha, bamboo, straw, cost and availability of biorefinery feedstocks, pre-treatments of biomass.

Module 3:Biorefinery types (based on platforms, products, feedstock, processes) and their features - C6 sugar platform biorefinery, Syngas platform biorefinery, C6 & C5 sugar and syngas platform biorefinery, SWOT (Strength, Weakness, Opportunities and Threat) analysis on a biorefinery, evaluating biorefinery performance, Life cycle analysis (LCA).

Module 4:Biochemical conversion, enzymes for biochemical conversion and their properties - cellulases, xylanases, amylases, lignin-degrading enzymes, Fermentation - Production of platform chemicals, and their properties and uses - Lactic acid and Polylactic acid, Succinic acid, Acetic, Butyric and Itaconic acids.

Thermochemical Processing of Biomass, General features of thermochemical conversion processes, Combustion, Pyrolysis, Gasification, bio-oil, bio-oil refining, bio-oil upgrading, Thermochemical Processing of Bio-Oil into Fuels, Methanol Production, Bio-Oil Co-Processing in Crude Oil Refinery, chemicals from thermochemical processing

Module 5: Algae Biorefineries- basic principles, CO2 capture, biological kinetics and yields, algae cultivation, open pond cultivation, photobioreactors, algae harvesting and oil extraction, algae biodiesel production, heterogeneous catalysts for transesterification, algae biorefinery integration, Life Cycle Assessment of algae biorefineries and environmental implications, Economic analysis.

Reference books:

1. Jhuma Sadhukhan, KokSiew Ng, Elias Martinez Hernandez, *Biorefineries and Chemical Processes: Design, Integration and Sustainability Analysis*, John Wiley & Sons, 2013.
2. Paul R. Mahmoud M. El-Halwagi, *Integrated Biorefineries: Design, Analysis, and Optimization*, CRC Press, 2013.

3. Chinnappan Baskar, Shikha Baskar, Ranjit S. Dhillon (Eds), *Biomass Conversion: The Interface of Biotechnology, Chemistry and Materials Science*, Springer, 2012.
4. Shang-Tian Yang, Hesham El-Ensashy, NutthaThongchul, *Bioprocessing Technologies in Biorefinery for Sustainable Production of Fuels, Chemicals and Polymers*. John Wiley & Sons, 2013.
5. Ashok Pandey, Rainer Höfer, Mohammad Taherzadeh, Madhavan Nampoothiri, Christian Larroche (Eds), *Industrial Biorefineries& White Biotechnology*, Elsevier, 2015.

Course contents and Lecture schedule

No.	Syllabus	No. of Lectures
1.1	**Fundamentals of Biorefinery**- Need for biorefinery, biorefinery principles, environmental aspects of biorefineries, Biorefinery products - biofuels such as ethanol, biodiesel, butanol, hydrogen, and biogas, biochemicals, and biopolymers, specialty chemicals and food ingredients, building block chemicals, Policy issues in biofuels, Indian biofuel programme.	**7**
2.1	**Biorefinery feedstocks and their characteristics** - sugars, starch, oil, microalgae, energy crops - corn, soybeans, and sugarcane. Lignocellulosic biomass - wood, wood wastes and forestery residues, Lignocellulosic energy crops - *Miscanthus* spp. and various grasses, jatropha, bamboo, straw, cost and availability of biorefinery feedstocks, pre-treatments of biomass.	**7**
3.1	**Biorefinery types** (based on platforms, products, feedstock, processes) and their features - C6 sugar platform biorefinery, Syngas platform biorefinery, C6 & C5 sugar and syngas platform biorefinery, SWOT (Strength, Weakness, Opportunities and Threat) analysis on a biorefinery, evaluating biorefinery performance, Life cycle analysis (LCA).	**7**
4.1	**Biochemical conversion**, enzymes for biochemical conversion and their properties - cellulases, xylanases, amylases, lignin-degrading enzymes, Fermentation - Production of platform chemicals, and their properties and uses - Lactic acid and Polylactic acid, Succinic acid, Acetic, Butyric and Itaconic acids.	**4**
4.2	**Thermochemical Processing of Biomass**, General features of thermochemical conversion processes, Combustion, Pyrolysis, Gasification, bio-oil, bio-oil refining, bio-oil upgrading, Thermochemical Processing of Bio-Oil into Fuels, Methanol Production, Bio-Oil Co-Processing in Crude Oil Refinery, chemicals from thermochemical processing	**3**
5.1	**Algae Biorefineries**- basic principles, CO2 capture, biological kinetics and yields, algae cultivation, open pond cultivation, photobioreactors, algae harvesting and oil extraction, algae biodiesel production, heterogeneous	**7**

	catalysts for transesterification, algae biorefinery integration, Life Cycle Assessment of algae biorefineries and environmental implications, Economic analysis.	
	Total lecture hours	**35**

BTT 434	BIOPHARMACEUTICAL TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: To give an insight into various biopharmaceutical products, therapeutics and clinical uses, understand the dynamics of drug absorption, distribution and metabolism, conventional drug development process and regulatory procedures and production of selected biopharmaceutical products.

Prerequisite: Knowledge about biochemistry, genetic engineering.

Course Outcomes: After the completion of the course the student will be able to

CO1	Identify various categories of biopharmaceuticals and their uses.
CO2	Explain the process of drug absorption, distribution, metabolism and elimination.
CO3	Elucidate the importance of pharmacokinetic models and their applications.
CO4	Explain the approaches to drug discovery and development
CO5	Describe the production of selected biopharmaceutical products

Mapping of course outcomes with program outcomes:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2		1			2						
CO2	3											
CO3	2		2			2		1				
CO4	3	2	3		2	3	3					3
CO5	2	2	2		2			2				2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution:

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 subdivisions and carry 14 marks.

Course Level Assessment Questions:

Course Outcome 1 (CO1):Identify various categories of biopharmaceuticals and their uses.

1. Pharmaceutical products, sources of biopharmaceuticals and pharmaceutical biotechnology
2. Development of pharmaceutical industry in the world

Course Outcome 2 (CO2): Explain the process of drug absorption, distribution, metabolism and elimination.

1. Drug delivery
2. Dynamics of drug absorption, distribution, metabolism and elimination
3. Mechanism of drug action & drug receptors

Course Outcome 3 (CO3): Elucidate the importance of pharmacokinetic models and their applications.

1. Pharmacokinetic models one, two and multiple compartment models, non-compartment models and physiologic models,
2. Pharmacokinetic models applications

Course Outcome 4 (CO4): Explain the approaches to drug discovery and development

1. Drug Discovery and drug development: sources of drugs
2. Conventional drug development process
3. Regulatory procedures,role of FDA

Course Outcome 5 (CO5): Describe the production of selected biopharmaceutical products

1. Biopharmaceutical therapeutics
2. Production of selected biopharmaceutical products

Model Question Paper

			Total Pages:
Reg No.:		**Name:**	
		APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY _________SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__	
		COURSE CODE: BTT434	
		COURSE NAME: BIOPHARMACEUTICAL TECHNOLOGY	
Time: 3 hrs			**Marks:100**
		PART A	
		Answer all questions. Each question carries 3 marks.	
1.		List any three sources of biopharmaceuticals and explain its significance.	3
2.		What are 'Biopharmaceuticals'?Give examples.	3
3.		Interpret ADME of a drug and list the different methods used for administration of a drug.	3
4.		Define the terms bioavailability and bioequivalence.	3
5.		Write a note on non-linear pharmacokinetics with suitable graphs.	3
6.		Define (i) MRT (ii) MDT	3
7.		What are clean rooms? How are they maintained?	3
8.		Comment on the characteristics that make yeast cells (Saccharomyces cerevisiae) a source of recombinant, therapeutic proteins. Give the disadvantages if any.	3
9.		What are cardiovascular drugs used for? Substantiate your answer with examples	3
10.		List the clinical use of any 3 glycoproteins, comment on their therapeutical applications.	3
		PART B	
		Answer any one full question from each module. Each question carries 14 marks.	
		Module 1	
11.		Brief out the current global market scenario in the field of biopharmaceutical industry with a case study.	14
		OR	
12.		List out any 5 biopharmaceutical companies in the world. Explain the rise	14

		and growth of any international pharmaceutical company.	
		Module 2	
13.		Comment on the different types of drug receptors. Describe the signal transduction process of G-protein coupled receptors & receptor tyrosine kinases.	14
		OR	
14.		Discuss in detail the absorption and metabolism of drugs in human body.	14
		Module 3	
15.		Elaborate on the different pharmacokinetic models. Give their advantages and disadvantages.	14
		OR	
16.	a	Differentiate between pharmacokinetic and pharmacodynamics.	7
	b	Discuss on the various types of compartment models used in pharmacokinetics	7
		Module 4	
17.		Elaborate on the upstream and downstream processing procedures used to produce a finished biopharmaceutical product	14
		OR	
18.	**a**	Discuss the role of regulatory authorities in drug development process.	14
	b	Elaborate on Indian drug and cosmetic act. Comment on its amendments.	
		Module 5	
19.		Explain in detail the production of engineered insulin or growth factor with schematic diagrams	14
		OR	
20.		What are the different types of interferons and interleukins? How are they important to human beings? Comment on their clinical uses with an example.	14

Syllabus

Various categories of biopharmaceuticals and their therapeutic and clinical uses, drug absorption, distribution, metabolism and elimination (ADME), bioavailability and bioequivalence of drugs, pharmacokinetic models and their applications, drug development, pre-clinical trials and clinical trials, regulations and manufacturing process, manufacture of selected biopharmaceutical products, stabilisation of biopharmaceutical products and finished product formulations, preservation of drugs.

Module 1: Introduction to pharmaceutical products, sources of biopharmaceuticals and pharmaceutical biotechnology, development of pharmaceutical industry in India, current and future status of biopharmaceutical sector-case studies, leading Indian pharma companies, Economics of drug industry.

Module 2: Drug delivery ,Dynamics of drug absorption, distribution, metabolism (Biotransformation - phase I, II reactions), and elimination (ADME), bioavailability of drugs, Bioequivalence its importance and determination, physicochemical factors affecting all the above, mechanism of drug action, drug receptors- G-protein coupled receptors (monomeric transmembrane proteins), small molecule receptors, neuropeptide receptors, ion channels (monomeric multi-transmembrane)proteins, ligand-gated ion channels (Oligomeric transmembrane proteins), transporters (multi-transmembrane proteins), plasma drug concentration - time profile..

Module 3: Pharmacokinetic models and their applications- one, two and multiple compartment models, non-compartment models and physiologic models, applications and limitation of physiologic pharmacokinetic models, mean residence time (MRT), statistical moments theory, mean absorption time (MAT), mean dissolution time (MDT), non-linear kinetics.

Module 4: Drug Discovery and drug development: sources of drugs - plant, animals, microbes and minerals, conventional drug development process-drug discovery, pre-clinical trials, clinical trials, Stabilisation of biopharmaceutical products and finished product formulations, excipients, Preservation of drugs, Packing of drugs. Regulatory procedures, approval. Role of FDA, Important amendments in drugs regulation- Indian drugs and cosmetic act. International pharmacopeia, guide to good manufacturing practice, manufacturing facility.

Module 5: Biopharmaceutical therapeutics (description and uses only): Cytokines – interferon, interleukins, tumour necrosis factor, heamopoietic growth factors-colony stimulating factor (granulocyte, macrophage), erythropoietin. Hormones – insulin, antibodies, glycoproteins, bacterial vaccines, cardiovascular drugs, hematopoietic agents. Anticoagulants, anthrombotics and hemostatics. Chemotherapeutic Agents, Endocrine Drugs Oligonucleotides, oligosaccharides, Production of selected biopharmaceutical products-Therapeutic Proteins, Hormones, Interferons, Interleukins I & II, Tumor Necrosis Factor, antibiotics, Nucleic acids.

Text Books:

1. D M Brahmankar, Sunil B Jaiswal,Biopharmaceuticals and Pharmacokinetics a Treatise, Vallabh Prakashan, 2017

Reference books:

1. Gary Walsh, Pharmaceutical Biotechnology: Concepts and Applications, John Wiley & Sons, 2007.
2. C Kokate, SS Jalalpure, H J Pramod, Textbook of Pharmaceutical Biotechnology, Elsevier, 2011.

3. Joseph D. Nally, Good Manufacturing Practices for Pharmaceuticals, CRC Press, 2013.
4. Leon Lachman, Herbert A Lieberman, Joseph L. Kanig, Theory & Practice of Industrial Pharmacy, 4/e, CBS Publishers, 2013.
5. Heinrich Klefenz, Industrial Pharmaceutical Biotechnology, John Wiley, 2002.
6. Hillery A. M., Lloyd A. W. and J. Swarbrick, Drug Delivery and Targeting, Harwood Academic Publishers

Course contents and Lecture schedule

No.	Topic	No. of Lectures
1.1	**Introduction** to pharmaceutical products, sources of biopharmaceuticals, pharmaceutical biotechnology.	2
1.2	**Development of pharmaceutical industry** -in India, current and future status of biopharmaceutical sector-case studies, leading Indian pharma companies. Economics of drug industry.	3
2.1	ADME of Drug – Drug delivery, Dynamics of drug absorption, distribution, metabolism (Biotransformation - phase I, II reactions), and elimination , bioavailability of drugs, Bioequivalence its importance and determination, physicochemical factors affecting all the above, mechanism of drug action.	3
2.2	Drug receptors- G-protein coupled receptors (monomeric transmembrane proteins), small molecule receptors, neuropeptide receptors, ion channels (monomeric multi-transmembrane)proteins, ligand-gated ion channels (Oligomeric transmembrane proteins), transporters (multi-transmembrane proteins).	3
3.1	Pharmacokinetic models and their applications- one, two and multiple compartment models, non-compartment models and physiologic models, applications and limitation of physiologic and pharmacokinetic models.	3
3.2	Plasma drug concentration - time profile, mean residence time (MRT), statistical moments theory, mean absorption time (MAT), mean dissolution time (MDT), non-linear kinetics.	3
4.1	Drug Discovery and drug development: sources of drugs - plant, animals, microbes and minerals, conventional drug development process-drug discovery, pre-clinical trials, clinical trials, Stabilisation of biopharmaceutical products and finished product formulations, excipients, Preservation of drugs, Packing of drugs.	5
4.2	Regulatory procedure- approval, role of FDA, Important amendments in drugs regulation- Indian drugs and cosmetic act. International pharmacopeia, guide to good manufacturing practice, manufacturing facility.	4
5.1	Biopharmaceutical therapeutics (description and uses only) -various categories of therapeutics: Cytokines – interferon, interleukins, tumour necrosis factor, haematopoietic growth factors-colony stimulating factor	5

	(granulocyte, macrophage), erythropoietin. Hormones – insulin, antibodies, Oligonucleotides, oligosaccharides, glycoproteins, bacterial vaccines, cardiovascular drugs, hematopoietic agents, Anticoagulants, anthrombotics, haemostatics, Chemotherapeutic Agents, Endocrine Drugs	
5.2	Production of selected biopharmaceutical products (any one from each type)- Therapeutic Proteins, Hormones, Interferons, Interleukins, Tumor Necrosis Factor, antibiotics, Nucleic acids.	4
	Total lecture hours	**35**

BTT444	EFFLUENT / WASTE WATER TREATMENT	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:
Have a basic knowledge about fundamental treatment methods.

Prerequisite: NIL
Course Outcomes: After the completion of the course the student will be able to

CO 1	Know the characteristics of wastewater and the reactor set up.
CO 2	Understand and develop design aspects of different filters.
CO 3	Estimate the design and selection of various sewage treatment methods.
CO 4	Enunciate sludge treatment and disposal methods.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	2	2	-	2	-	-	-	-	-	-
CO2	3	2	3	-	-	2	2	-	-	-	-	-
CO3	2	2	-	-	-	2	2	-	-	-	-	2
CO4	2	2	-	-	-	2	-	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Know the characteristics of wastewater and reactor set up.

1. What are the applications of batch and continuous reactors?
2. Brief about the hydraulic profile in waste water treatment.

Course Outcome 2 (CO2): Understand and develop design aspects of different filters

1. Briefly explain the shape characteristics of filtering media.
2. Describe rapid and slow sand filter with the help of neat sketches.

Course Outcome 3(CO3): Estimate the design and selection of various sewage treatment methods.

1. Write a short note on sequencing batch reactor.
2. Describe in detail about single and two stage trickling filter.

Course Outcome 4 (CO4): Enunciate sludge treatment and disposal methods.

1. Write a short note on sludge thickening.
2. Explain the design of a gravity thickener with the help of a neat sketch.

Model Question paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGTH SEMESTER B. TECH DEGREE EXAMINATION___20__

Course Code: BTT444

Course Name: EFFLUENT / WASTE WATER TREATMENT

Max. Marks: 100	Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	Explain why waste water characterization is needed.
2.	Show the various steps involved in waste water treatment with the help of a flow diagram.
3.	List down the different types of filtering media.
4.	Briefly describe the design considerations of a radial flow filter.
5.	Compare coagulation and flocculation.
6.	Why maintenance is important for primary treatment units?
7.	Define sludge solids retention time in ASP design
8.	What do you mean by the term recirculation ratio in trickling filter?
9.	What is the difference between raw sludge and secondary sludge?
10.	Enlist the factors affecting sludge digestion.

PART B

Answer any one full question from each module. Each carry 14 marks.

Module 1

11.	Enunciate Physical, Chemical and Biological characteristics of waste water	(14)
	OR	
12.	Describe the types of reactors used for waste water treatment with the help of neat sketches. Mention the advantages and disadvantages.	(14)
	Module 2	
13.	Enunciate the construction, working and applications of a pressure filter. Compare the high rate and multi- media filter.	(14)

		OR	
14.		Explain in detail about various Water softening methods. Give a brief note on Industrial water treatment for boilers.	(14)
		Module 3	
15.		Describe the working of a grit chamber and its types. Also write the design criteria for a grit chamber and brief its construction and functioning.	(14)
		OR	
16.		Classify the types of screens adopted in sewage treatment with a neat sketch. Also construct the design criteria for screen chamber.	(14)
		Module 4	
17.		Describe with neat sketches about the typical process flow diagram of an oxidation ditch and explain its working principle. Also Illustrate about waste stabilization ponds.	(14)
		OR	
18.		Discover how UASB is related with treatment of waste water. Write in detail about the UASB reactor with a neat sketch, advantages and disadvantages. Explain its function and operation.	(14)
		Module 5	
19.		What parameters will you consider while designing sludge digestion tank? Explain in detail about sludge conditioning and dewatering with a neat sketch.	(14)
		OR	
20.		Describe the mechanism of biogas recovery from sludge. Explain in detail about sludge drying beds.	(14)

***

Syllabus

Module 1 Objectives of wastewater treatment

Waste Water Characteristics: Physical, Chemical, Biological characteristics of waste water, flow variations, types of reactors and reactors analysis. Wastewater Treatment - Flow Diagrams and Hydraulic Profile.

Module 2: Filtration

Size and shape characteristics of filtering media – Sand filters, hydraulics of filtration – design considerations – radial, up flow, high rate and multimedia filters, pressure filter. Water softening- Lime soda, zeolite and demineralization processes-Industrial water treatment for Boilers

Module 3: Primary Treatment of sewage

Objectives-Unit operations and processes-Selection of treatment processes-Primary treatment – Principles, functions and design of sewage treatment units - Screens –equalization basin - grit chamber – primary sedimentation tanks- Construction, operation and maintenance aspects.

Module 4: Secondary treatment of sewage

Objectives-Selection of treatment methods-Principles, functions- Activated sludge process and extended aeration systems – Trickling filters – Sequencing batch reactor (SBR) - Membrane bioreactor – UASB – Waste Stabilization ponds – Other treatment methods – Reclamation and reuse of sewage – Recent advances in sewage treatment- Construction, operation and maintenance aspects.

Module 5: Sludge Treatment and Disposal.

Objectives — Sludge characterization — Thickening — Design of gravity thickener- Sludge digestion — Standard rate and High rate digester design- Biogas recovery — Sludge Conditioning and Dewatering — Sludge drying beds- ultimate residue disposal — recent advances.

Text Books

1. "*Wastewater Engineering - Treatment and Reuse*", Metcalf and Eddy Inc., (2003), 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. "*Wastewater Treatment Concepts and Design Approach*", Karia G.L., and Christian R.A., (2001), Prentice Hall of India Pvt. Ltd., New Delhi

Reference Books

1. Fair G.M., Geyer J.G and Okun, "*Water-wastewater Engineering*".
2. Manual on "*Sewerage and Sewage Treatment*" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Objectives of wastewater treatment**	
1.1	Waste Water Characteristics: Physical characteristics of waste water	1
1.2	Chemical, Biological characteristics of waste water	2
1.3	Flow variations, types of reactors and reactors analysis.	2
1.4	Wastewater Treatment - Flow Diagrams and Hydraulic Profile.	2
2	**Filtration**	
2.1	Size and shape characteristics of filtering media	1
2.2	Sand filters, hydraulics of filtration – design considerations – radial, up flow, high rate and multimedia filters, pressure filter	2
2.3	Water softening- Lime soda, zeolite and demineralization processes	2
2.4	Industrial water treatment for Boilers	1
3	**Primary Treatment of sewage**	
3.1	Objectives-Unit operations and processes-Selection of treatment processes.	2
3.2	Primary treatment – Principles, functions and design of sewage treatment units - - Screens –equalization basin - grit chamber	3
3.3	Primary sedimentation tanks- Construction, operation and maintenance aspects	2
4	**Secondary treatment of sewage**	
4.1	Objectives-Selection of treatment methods-Principles, functions- Activated sludge process and extended aeration systems	2
4.2	Trickling filters – Sequencing batch reactor (SBR) - Membrane bioreactor – UASB	2
4.3	Waste Stabilization ponds – Other treatment methods	1
4.4	Reclamation and reuse of sewage – Recent advances in sewage treatment-Construction, operation and maintenance aspects.	2
5	**Sludge Treatment and Disposal**.	
5.1	Objectives — Sludge characterization — Thickening — Design of gravity thickener	2
5.2	Sludge digestion — Standard rate and High-rate digester design	2
5.3	Biogas recovery — Sludge Conditioning and Dewatering	2
5.4	Sludge drying beds- ultimate residue disposal — recent advances.	2
	Total lecture hours	**35**

BTT454	DAIRY PROCESS TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:
To know in detail the various process in milk and dairy product production and processing

Prerequisite: Basics of heat and mass transfer operations

Course Outcomes: After the completion of the course the student will be able to:

CO 1	Grasp the perspectives of Indian dairy industry
CO 2	Discern the technologies involved in milk process sing
CO 3	Have a thorough knowledge and production techniques of the various milk products
CO 4	Interpret the quality parameters of milk and their determination methods

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	2	2	-	-	3	3
CO2	3	3	3	-	-	3	3	2	-	-	2	-
CO3	-	3	3	3	-	2	3	2	-	-	2	-
CO4	3	3	3	-	-	3	3	2	-	-	2	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Grasp the perspectives of Indian diary industry

1. Who is the master mind behind "Operation Flood" and what is the significance of the same?
2. What do you understand by the nutritive value of milk?
3. Brief on the environmental and feed factors which affects the quality of milk

Course Outcome 2: Discern the technologies involved in milk processing

1. Explain the factors involved in the spoilage of milk?
2. Explain the principles and process behind homogenization and pasteurization of milk
3. Discern the energy consumption in different milk processing operations

Course Outcome 3 (CO3): Have a thorough knowledge and production techniques of the various milk products

1. What are different kinds of cheese and how are they manufactured?
2. Explain the production and significance of three indigenous milk products
3. How is ice-cream manufactured?

Course Outcome 4 (CO4): Interpret the quality parameters of milk and their determination methods

1. How is the specific gravity of milk determined and what is its significance?
2. Which are the common adulterants in milk and how are they detected?
3. What is the importance of phosphatase in milk?

Model Question paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION_20__

Course Code: BTT454

Course Name: DAIRY PROCESS TECHNOLOGY

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	What is the role of milk in human nutrition?
2.	What are the environmental factors affecting the quality of milk?
3.	Define fermentation? What are the end products of milk fermentation?
4.	What are milk borne diseases? Give the name of two such diseases?
5.	What are factors taken into consideration for grading milk?
6.	What is pasteurization? What is the importance of the process?
7.	Explain the role of temperature in milk conservation?
8.	Does heat treatment of milk affect the nutritional quality of milk? If so, how does it do?
9.	How is the specific gravity of milk determined? Why is it important?
10.	What is the significance of MBR test in assessing milk quality?

PART B

Answer any one full question from each module. Each carry 14 marks.

Module 1

11.	Who is the father of White Revolution? What are his contributions in diary establishment and production through "Operation flood"	(14)
	OR	
12.	What are the components present in milk? Explain the nutritional significance of each of these	(14)
	Module 2	

13.		Describe on the various types of cultures and their significance and outcomes in the dairy industry?	(14)
		OR	
14.		What is the role of microbes in milk and dairy products? Describe both in the spoilage perspective and utility perspective?	(14)
		Module 3	
15.		Describe the various process right from milk collection to packaging in the dairy industry	(14)
		OR	
16.		What is the various fat rich dairy products? Describe in detail the production of any three-fat rich dairy products.	(14)
		Module 4	
17.		Describe on the various unit operations in a diary industry used for the processing of milk.	(14)
		OR	
18.		Discern on the different quality assurance strategies that are implemented in the dairy industry?	(14)
		Module 5	
19.		What are the common adulterants seen in milk? How are they detected and removed before or during processing	(14)
		OR	
20.		How is HPLC and FTIR used in analyzing milk and dairy products	(14)
		****	

Syllabus

Module I: Dairy Industry in India

Dairy development in India – Dairy Cooperatives – NDRI, NDDB, TCMPF -Operation Flood – Milk and Milk Products Order '92 – Nutritive value of milk ICMR recommendation of nutrient. Role of milk and milk products in human nutrition. Milk Composition – Physico Chemical properties of milk – Animal, Feed and Environmental factors influencing the composition of milk – Milk lipids, Proteins, Sugar and their biosynthesis, classes and significance – Minerals and Vitamins in Milk – Thermal stability of Milk – Freezing Point depression of Milk.

Module II: Dairy Microbiology

Milk and microbes – Common microorganisms in milk – spoilage of milk – Fermentation of milk - Desirable and undesirable fermentation – milk borne Diseases –clean milk production – Milk and Public Health – common starter cultures in dairy industry-their classification, characteristics and propagation.

Module III: Dairy Processing and Technology

Dairy processing – Milk collection, transportation & Grading of milk – Standardization – Pasteurization – Homogenization of milk - packaging of milk – cleaning and sanitation – Cleaning in Place (CIP)System of cleaning- Cleaning agents- Dairy technology – Manufacture of Fat rich dairy products- cream– butter – ghee – Ice cream – concentrated and dried milk products- cheese and other fermented products – manufacture of Dahi – Yoghurt – Shrikand – Indigenous milk products – Effective utilization of dairy by - products.

Module IV: Dairy Engineering

Pasteurizer, Homogenizer, Freezer, Evaporator – their Principles and designs - Boiler - Installation, operation and design - Boiler efficiency- Cream separators - Principle of Heat Exchange - Energy consumption in different milk processing operations – Refrigeration requirements in different dairy processing operations – Time/Temperature schedule for CIP of Tanker & Pipelines and Pasteurizers - Energy Conservation measures. Food safety and Quality assurance strategies – Implementation of HACCP/ ISO and certification – Packaging of Market Milk and Milk products – Advancements in Liquid Milk and Milk Products Packaging.

Module V: Quality Analysis of Milk

Sensory analysis of Milk – Determination of Specific gravity, fat, SNF, TS, Acidity & pH in milk and their significance and interpretation – Determination and significance of MBR Test – SPC – Phosphatase activity in milk – Common adulterants in milk and their detection techniques – Advanced analytical techniques in milk and milk products analysis.

Text Books

1. Sukumar Dey, *Outlines of Diary Technology* – Oxford University press
2. *Dairy Science*: Petersen (W.E.) Publisher – Lippincott & Company
3. *Outlines of Dairy Technology* – Sukumar (De) – Oxford University press
4. *Indian Dairy Products* – Rangappa (K.S.) & Acharya (KT) – Asia Publishing House.

Reference Books

1. *The Technology of Milk Processing* – Ananthakrishnan, C.P., Khan, A.Q. and Padmanabhan, P.N. – Shri Lakshmi Publications.
2. Dairy India 2007, Sixth edition
3. Economics of Milk Production – Bharati Pratima Acharya Publishers.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Diary Industry in India**	
1.1	Dairy development in India – Dairy Cooperatives – NDRI, NDDB, TCMPF	1
1.2	Operation Flood – Milk and Milk Products Order '92 – Nutritive value of milk ICMR recommendation of nutrient. Role of milk and milk products in human nutrition.	1
1.3	Milk Composition – Physico Chemical properties of milk – Animal, Feed and Environmental factors influencing the composition of milk –	1
1.4	Milk lipids, Proteins, Sugar and their biosynthesis, classes and significance	1
1.5	Minerals and Vitamins in Milk – Thermal stability of Milk – Freezing Point depression of Milk.	1
2	**Diary Microbiology**	
2.1	Milk and microbes – Common microorganisms in milk – spoilage of milk –	1
2.2	Fermentation of milk - Desirable and undesirable fermentation	2
2.3	Milk borne Diseases –clean milk production	2
2.4	Milk and Public Health – common starter cultures in dairy industry-their classification, characteristics and propagation	2
3	**Dairy Processing and Technology**	
3.1	Dairy processing – Milk collection, transportation & Grading of milk	2
3.2	Standardization – Pasteurization – Homogenization of milk - packaging of milk – cleaning and sanitation – Cleaning in Place (CIP)System of	2

	cleaning- Cleaning agents	
3.3	Dairy technology – Manufacture of Fat rich dairy products- cream– butter – ghee – Ice cream – concentrated and dried milk products- cheese and other fermented products – manufacture of Dahi – Yoghurt – Shrikand	2
3.4	Indigenous milk products – Effective utilization of dairy by - products.	2
4	**Dairy Engineering**	
4.1	Pasteurizer, Homogenizer, Freezer, Evaporator – their Principles and designs	2
4.2	Boiler - Installation, operation and design - Boiler efficiency- Cream separators - Principle of Heat Exchange - Energy consumption in different milk processing operations	2
4.3	Refrigeration requirements in different dairy processing operations – Time/Temperature schedule for CIP of Tanker & Pipelines and Pasteurizers	2
4.4	Energy Conservation measures. Food safety and Quality assurance strategies – Implementation of HACCP/ ISO and certification	2
4.5	Packaging of Market Milk and Milk products – Advancements in Liquid Milk and Milk Products Packaging.	2
5	**Quality Analysis of Milk**	
5.1	Sensory analysis of Milk – Determination of Specific gravity, fat, SNF, TS, Acidity & pH in milk and their significance and interpretation.	2
5.2	Determination and significance of MBR Test – SPC – Phosphatase activity in milk	1
5.3	Common adulterants in milk and their detection techniques	1
5.4	Advanced analytical techniques in milk and milk products analysis.	1
	Total lecture hours	**35**

BTT 464	OPERATIONAL RESEARCH	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble

Objective of this course is to introduce principles of Operations Research which is widely used in the area of decision making for the real life problems. Managers and decision makers use these techniques to get idea for optimizing and approximating industrial problems and also apply to monitor the organizations ongoing activities such as production mix, transportation, queuing, assignment etc. This course introduces students a basic concept in the techniques of Operational Research.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to

CO1	Select optimal problems solving techniques for a given problem using LP.
CO2	Formulate and solve transportation, travelling sales man and transshipment problems.
CO3	Formulate and solve optimization problems related to job/ work assignments.
CO4	Solve different problems related to Queueing & Simulation.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1		1					1	
CO2	3	2	1	1		1					1	
CO3	3	2	1	1		1					1	
CO4	3	2	1	1		1					1	

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyze			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.
Course level assessment questions

Course Outcome 1(CO1): Select optimal problems solving techniques for a given problem using LP.

1. Write down the applications of operations research with examples.
2. Write down the basic structure of a linear programming problem in the mathematical form.
3. Explain the concept of duality as applied to LPP.

Course Outcome 2 (CO2): Formulate and solve transportation, travelling sales man and transshipment problems.

1. Discuss how an unbalanced assignment problem can be solved.
2. Explain with a proper example, how a maximization assignment problem can be solved by the Hungarian method?
3. Discuss the use of North west corner rule.

Course Outcome 3 (CO3): Formulate and solve optimization problems related to job/ work assignments

1. Problems with n jobs through two machines
2. Problems based on PERT & CPM
3. Explain cost considerations in network analysis

Course Outcome 4 (CO4): Solve different problems related to Queueing & Simulation.

1. Explain the steps involved in the development of a simulation model
2. Problems based on Monte Carlo simulation.
3. Write down the assumptions of the basic inventory model.

Model Question Paper

			Total Pages:
Reg No.:______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEMESTER B. TECH DEGREE EXAMINATION_________20__

Course Code: BTT 464

Course Name: OPERATIONAL RESEARCH

Max. Marks: 100	Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	Write down the basic structure of a linear programming problem in the mathematical form.
2.	Explain the concept of duality as applied to LPP.
3.	What do you mean by infeasibility and unboundedness in linear programming?
4.	Discuss how an unbalanced assignment problem can be solved.
5.	Explain travelling salesman problem.
6.	Enumerate reasons for maintaining inventory in a firm.
7.	What is the use of crashing of networks? Why it is done?
8.	Define CPM and PERT. Discuss the differences between them.
9.	Classify simulation models under different criteria.
10.	Name the steps involved in the development of a simulation model.

PART B

Answer any one full question from each module. Each carries 14 marks.

11.	Use 2 Phase method to solve Maximize Z= 5x-4y+3z Subject to 2x+y-6z=20; 6x+5y+10z≤76; 8x-3y+6z≤50; x, y, z≥0
	OR
12.	Explain different types of models used in operations research. Explain different methods used for solving these.
13.	Explain with a proper example, how a maximization assignment problem can be solved by the Hungarian method?

	OR
14.	There are five jobs, each of which has to go through two machines A and B in the order A-B. The processing times of each job in the machines are as follows. Job | J1 | J2 | J3 | J4 | J5 Machine1 | 5 | 1 | 9 | 3 | 10 Machine2 | 2 | 6 | 7 | 8 | 4 Determine the sequence which minimizes the total elapsed time. What is the idle time each machine.
15.	An aircraft company uses rivets at an average customer rate of 2500 kg per year. Each unit costs Rs. 30/- per kg and the company personnel estimate that it costs Rs. 130/- to place an order. The carrying cost of the item is 10% per year. How frequently the orders for the rivets be made? What is the optimum order quantity and time between orders?
	OR
16.	The time to repair electronic equipment is distributed exponentially with mean 30 minutes. The equipment arrives for repair at an average rate of ten per eight hour day. Determine the average time the repairman is idle in each day? What is the average number of items in the repair shop?
17.	Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and next. The length of the phone call is assumed to be distributed exponentially with mean three minutes. a) What is the probability that a person arriving at booth will have to wait. b) What is the average length of the queue. c) The telephone department will install a second booth when convinced that an arrival would have to wait at least 3 minutes for the phone. By how much time must of arrivals be increased in order to justify for a second booth.
	OR
18.	Derive an expression for Economic Order Quantity and Total Minimum Cost for a purchase model without shortage
19.	An inventory system faces demand for items in every week, the quantity of demand being distributed uniformly between 12 and 20 units. The items are supplied against the demand by the rule: minimum of demand or stock, if stock is positive. Whenever the stock comes below 30, a replenishment order is placed with the supplier for a fixed quantity of 50 units. The replenishments are realized on the immediate next week end. Orders are placed at the end of a week, if needed. Starting with a stock of 40 units, simulate the system for the next ten weeks. Use the following random numbers for generating demand for these weeks. Note down the number of weeks with the situations of no stock in the system.

	OR
20.	a) Define simulation. Classify simulation models under different criteria. b) Discuss the phases of simulation study by a neat flow chart. Select a bank as an example system with an objective to study and propose alternate queuing system.

SYLLABUS

Module I

Basics of Operations Research, Linear programming problems - Mathematical formulation, graphical method of solution, simplex method, Big-M method, Two–phase method.

Module II

Transportation problems, North west corner rule – least cost method, Vogel's method –stepping stone method, MODI method, Assignment problems, Hungarian algorithm, Variants of assignment problems, Traveling salesman Problem.

Module III

Sequencing problem– terminology and notations – assumptions – problems with n jobs through two machines, Problems with n jobs through three machines, Problems with n jobs through m machines. Network analysis – basic terms – network construction – time analysis

Critical path method (CPM), Programme evaluation and review technique (PERT), Cost considerations in network analysis – crashing

Module IV

Queueing theory -basic structure of queuing systems, Single server problems, Multi server problems, Inventory control – variables – deterministic inventory models – purchasing model without shortages, Manufacturing model without shortages, Purchasing model with shortages

Manufacturing model with shortages

Module V

Simulation: simulation concepts, types of simulation – phases of simulation –applications– advantages and disadvantages

Design of simulation, models & experiments, model validation, Generation of random numbers, Monte Carlo simulation, Queuing simulation model, Inventory simulation model, Simulation languages

Text Books

1. Miller, D. M. and Schmidt, J. W., Industrial Engineering and Operations Research, John Wiley & Sons, Signapore, 1990.
2. Paneerselvam, R., Operations Research, Prentice Hall of India, New Delhi, 2008.
3. Pannerselvam, R., Design and Analysis of Algorithms, Prentice Hall of India, New Delhi, 2007.
4. Srinivasan, G. “Operations Research-Principles and Applications”, Latest edition, PHI Pvt. Ltd., 2010.
5. Taha, H. A., Operations Research, Pearson, 2004.

Reference Books

1. Banks, J., Carson, J. S., Nelson, B. L., and Nicol, D. M., Discrete-Event System Simulation, Third Edition, Pearson Education, Inc., 2001.
2. Goel, B. S. and Mittal, S. K., Operations Research, Pragati Prakashan, Meerut, 1999.
3. Ravindran, Phillips and Solberg, Operations Research Principles and Practice, Willey & Sons, 1987.

Course Contents and Lecture Schedule

No.	Topic	No. of Lectures
1	**Linear Programming**	**7**
1.1	Basics of Operations Research, OR-models, applications	1
1.2	Linear programming – problem formulation	1
1.3	Graphical method	1
1.4	Simplex method	1
1.5	Big-M method ,Two–phase method	2
1.6	Duality in linear programming	1
2	**Transportation problem**	**7**
2.1	Transportation problem – formulation – balanced & unbalanced transportation problems	1
2.2	North west corner rule – least cost method	1
2.3	Vogel’s method –stepping stone method	1
2.4	MODI method	1
2.5	Assignment problem – formulation – optimal solution, Hungarian algorithm	1
2.6	Variants of assignment problems	1
2.7	Traveling salesman problem.	1
3	**Sequencing problem**	**7**
3.1	Terminology and notations – assumptions – problems with n jobs through two machines	1

3.2	Problems with n jobs through three machines	1
3.3	Problems with n jobs through m machines.	1
3.4	Network analysis – basic terms – network construction – time analysis	1
3.5	Critical path method (CPM)	1
3.6	Programme evaluation and review technique (PERT)	1
3.7	Cost considerations in network analysis – crashing	1
4	**Queuing theory**	**7**
4.1	Introduction to queuing theory–terminologies– classification of queuing models	1
4.2	Single server problems	1
4.3	Multi server problems	1
4.4	Inventory control – variables – deterministic inventory models – purchasing model without shortages	1
4.5	Manufacturing model without shortages	1
4.6	Purchasing model with shortages	1
4.7	Manufacturing model with shortages	1
5	**Simulation**	**7**
5.1	Types of simulation – phases of simulation –applications– advantages and disadvantages	1
5.2	Design of simulation, models & experiments, model validation	1
5.3	Generation of random numbers	1
5.4	Monte Carlo simulation	1
5.5	Queuing simulation model	1
5.6	Inventory simulation model	1
5.7	Simulation languages	1

PROGRAM ELECTIVE IV

BTT416	Cancer Biology	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: An introduction to the fundamentals of cancer biology, its clinical manifestation and detection and the therapeutic means available for treatment

Prerequisite: Basic knowledge in Biochemistry and Molecular Biology

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand how cancer manifests itself in the human body.
CO 2	Exemplify the various factors that influence cancer susceptibility.
CO 3	Articulate how latest technologies provide insights into cancer prevention, diagnosis, and treatment.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO		-	-	2	-	2	-	-	-		-	2
CO		-	-	2	-	2	-	-	-	-		2
CO		-	-	2	-	2	-		-	-		2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions (Minimum 3 questions per CO)

Course Outcome 1 (CO1): Understand how cancer manifests itself in the human body.

1. How can cancers be classified?
2. What are cell signalling molecules?
3. Justify the role of apoptosis.

Course Outcome 2 (CO2): Exemplify the various factors that influence cancer susceptibility

1. Recall the role of microbiome in cancer.
2. Justify the role of detection of tumour markers.
3. What is cancer metastasis

Course Outcome 3(CO3): Articulate how latest technologies provide insight into cancer prevention, diagnosis, and treatment.

1. What are the latest technological developments in treatment of cancer?
2. Describe in details about the imaging technologies used in cancer detection.
3. Describe in detail about tumour suppressor genes.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 416

Course Name: Cancer Biology

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.	
1.		Justify the role of tumour markers.	
2.		What is PSA? How is it significant	
3.		What is sarcoma?	
4.		Give the significance of PSA	
5.		Brief about Wnt signalling.	
6.		Describe the role of basement membrane disruption.	
7.		Justify the use of imaging techniques in cancer detection.	
8.		Describe the role of diet in cancer.	
9.		How does cell signalling play a role in maintenance of cell integrity	
10.		What is the role of oncogenes ?	

PART B

Answer any one full question from each module. Each carries 14 marks.

11.	a)	Does mutations always cause cancer? Justify.	7
	b)	Describe the TNM classification of cancer.	7
		OR	
12.	a)	Regulation of cell cycle plays a major role. Exemplify.	7
	b)	Briefly discuss about the various pathways for apoptosis.	7
13.	a)	Discuss the role of physical agents in carcinogenesis.	9
	b)	What is the role of diet in cancer?	5
		OR	
14.	a)	Metabolic reprogramming is resulted in carcinogenesis. Analyze the given statement.	14
15.		Gain-of-function mutation convert proto-oncogene to oncogene. Justify.	14
		OR	
16.	a	How has detection and quantification of tumour markers helped in cancer therapy.	14
17.	a	Describe the role of proteinases in cell cycle regulation and cancer.	7
	b	In what capacity does basement membrane affect cancer metastasis?	7

		OR	
18.	a)	Explain in detail about the various cell signalling pathways.	14
19.	a)	Describe the principle of various oncological imaging techniques.	14
		OR	
20.	a)	Describe in detail about the various forms of cancer therapy.	14
		****	

Syllabus

Module 1:

Fundamentals of Cancer Biology Regulation of Cell cycle, role of signalling molecules, mutations that cause changes in signal molecules, effects on receptor. Apoptosis-extrinsic and intrinsic pathways. Modulation of cell cycle in cancer. Different forms of cancers. TNM Classification.

Module 2:

Principles of Carcinogenesis Chemical Carcinogenesis- Principle, types, Metabolism of Carcinogenesis. Physical Carcinogenesis, X-Ray radiation – mechanisms of radiation Carcinogenesis. Diet and cancer.

Module 3:

Molecular Cell Biology of Cancer Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, detection of Oncogenes. Oncogenes/Proto Oncogene activity. Tumour suppressor genes-role and significance. Cancer markers-PSA,CA, case study

Module 4:

Clinical significances of invasion in Cancer Growth factors related to transformation. Cell signalling pathways- Ras-MAPK pathway ,JAK-STAT pathway, Wnt signalling pathway. Heterogeneity of metastatic phenotype. Metastatic cascade. Basement Membrane disruption. Three step theory of Invasion, Proteinases and tumour cell invasion.

Module 5:

New Molecules for Cancer Therapy Screening methods for Cancers, different forms of therapy, Chemotherapy, Radiation therapy. Prediction of aggressiveness of cancer, advances in cancer detection. Immunotherapy in cancer treatment. Influence of microbiome on cancer. Oncological imaging- CT,MRI,PET.

Text Books

1. King R.J.B., *Cancer Biology*, Addision Wesley Longmann Ltd, U.K., 1996.
2. Ruddon.R.W., *Cancer Biology*, Oxford University Press, Oxford, 1995.

Reference Books

1. Maly B.W.J "*Virology a practical approach*". IRL Press. Oxford, 1987.
2. Dunmock N.J.,Easton.A.J., and Leppard.K.N., "*Introduction to Modern Virology*". Blackwell Scientific.Sixth Edition.2007.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module 1-Fundamentals of Cancer Biology** Regulation of Cell cycle, role of signalling molecules	**1**
2	Mutations that cause changes in signal molecules, effects on receptor	**1**
3	Apoptosis-extrinsic and intrinsic pathways	**2**
4	Modulation of cell cycle in cancer	**1**
5	Different forms of cancers. TNM Classification.	**1**
6	**Module 2:Principles of Carcinogenesis** Chemical Carcinogenesis- Principle, types	**1**
7	Metabolism of Carcinogenesis.	**2**
8	Physical Carcinogenesis	**1**
9	X-Ray radiation – mechanisms of radiation carcinogenesis	**1**
10	Diet and cancer	**1**
11	**Module 3:Molecular Cell Biology of Cancer** Oncogenes, Identification of Oncogenes	**1**
12	Retroviruses and Oncogenes	**1**
13	Detection of Oncogenes	**2**
14	Oncogenes/Proto Oncogene activity	**1**
15	Tumour suppressor genes-role and significance	**1**
16	Cancer markers-PSA,CA, case study	**2**
17	**Module 4: Clinical significances of invasion in Cancer** Growth factors related to transformation.	**1**
18	Cell signalling pathways- Ras-MAPK pathway ,JAK-STAT pathway, Wnt signalling pathway	**3**
19	Heterogeneity of metastatic phenotype	**1**
20	Metastatic cascade. Basement Membrane disruption	**1**
21	Three step theory of Invasion	**1**
22	Proteinases and tumour cell invasion	**2**
23	**Module 5: New Molecules for Cancer Therapy** Screening methods for cancers, different forms of therapy, Chemotherapy, Radiation therapy.	**2**
24	Prediction of aggressiveness of cancer	**1**
25	Advances in cancer detection	**1**
26	Immunotherapy in cancer treatment, Influence of microbiome on cancer	**1**
27	Oncological imaging- CT,MRI,PET	**2**

BTT426	ADVANCED SEPARATION PROCESSES	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Study in detail the membrane-based separation process

Prerequisite: Basic knowledge of basic unit operations and different types of filtration

Course Outcomes: After the completion of the course the student will be able to

CO 1	Distinguish various membrane separation processes
CO 2	Explain common membrane materials and their characteristics.
CO 3	Analyse the principle, applications of non- conventional separation processes.
CO 4	Differentiate between various chromatographic techniques

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	-	-	-	-	-	-	-	2
CO2	2	-	-	-	-	-	1	-	-	-	-	2
CO3	2	-	-	-	2	-	1	-	-	2	-	2
CO4	2	-	-	-	3	-	1	-	-	2	-	1

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

t

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Distinguish various membrane separation processes

1. Classify membranes based on pore characteristics
2. Discuss various methods of membrane synthesis

Course Outcome 2 (CO2): Explain common membrane materials and their characteristics.

1. Explain the major types of membranes and their subclasses
2. Differentiate between pore flow model and solution diffusion model

Course Outcome 3(CO3): Analyse the principle, applications of non- conventional separation processes.

1. Distinguish between azeotropic and extractive distillation?
2. Explain the principle of supercritical extraction and pressure swing adsorption

Course Outcome 4 (CO4): Differentiate between various chromatographic techniques

1. Explain the principle of Affinity monolith chromatography
2. Differentiate between Chiral chromatography & expanded bed chromatography

Model Question paper

			Total Pages:
Reg No.:______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION_20__

Course Code: BTT426

Course Name: ADVANCED SEPARATION PROCESSES

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.		Enlist 3 advantages and disadvantages of membrane separation process	(3)
2.		Classify membrane separation process based on the major driving forces	(3)
3.		What is Van't Hoff's law in osmotic process? Explain the role of osmotic pressure in ultrafiltration	(3)
4.		What are the factors that affect flux in filtration process	(3)
5.		Explain the control techniques employed for increasing the flux	(3)
6.		Give an account of electrodialysis	(3)
7.		Differentiate between Affinity and Affinity monolith chromatography?	(3)
8.		Define selectivity factor, retention factor and partition coefficient	(3)
9.		Write a note on band broadening and column efficiency in chromatography	(3)
10.		Discuss the principle of membrane chromatography	(3)

PART B

Answer any one full question from each module. Each carry 14 marks.

11.		Compare and contrast RO and UF in terms of size of solute retained, osmotic pressure and nature of membrane retention	(14)
		OR	
12.	a)	Explain the basic difference in transport mechanism of a charged and uncharged molecule in NF	(10)
	b)	List out the parameters affecting the performance of NF membranes	(4)
13.		Explain the most commonly used membrane module designs with neat sketch	(14)
		OR	
14.		Explain the various membrane synthesis techniques	(14)
15.	a)	What are the factors that affect filtration process?	(7)
	b)	Explain the control techniques employed for increasing the flux	(7)
		OR	
16.		Explain the process of concentration polarization and membrane fouling in Membrane separation process	(14)
		OR	

17.		Explain the working principle and applications of Pressure swing adsorption with neat sketch.	(14)
		OR	
18.		Principle, applications, advantages and disadvantages of Azeotropic and Extractive distillation	(14)
19.	a)	Differentiate between Affinity and Affinity monolith chromatography?	(10)
	b)	Define selectivity factor, retention factor and partition coefficient	(4)
		OR	
20.		Describe the principle and applications of gas and supercritical fluid extraction theory	(14)
		****	

Syllabus

Module 1: An overview of membrane separation process

Membrane separation-classification of membrane separation processes-dead end and cross flow filtration, ultrafiltration, microfiltration, nanofiltration, reverse osmosis, dialysis, electrodialysis, pervaporation, advantages and disadvantages, major areas of application.

Module 2: Membrane materials, structure, and preparation techniques

Types of membranes, characteristics of membrane pore structures-pore size, pore size distribution, pore density and surface roughness, permeability and membrane resistance, membrane preparation methods, membrane modules-plate and frame, tubular, spiral wound, hollow fibre and capillary module, and their relative merits and demerits.

Module 3: Transport mechanisms in membranes

Driving forces for transport mechanisms, transmembrane flux, retention factor or separation factor, selectivity, factors affecting retentivity, concentration polarization, gel polarization, fouling, cleaning and regeneration of membranes, turbulence enhancers, membrane separation models-Irreversible thermodynamics, Capillary flow theory, Solution diffusion model, Viscous flow models.

Module 4: Non-conventional separation processes

Principle, applications, advantages and disadvantages of Azeotropic and Extractive distillation, Reactive distillation, Membrane distillation, Reactive extraction, Cloud point extraction, Supercritical fluid extraction, Separation using surfactants, Field Flow Fractionation/Gradient Separation, Pressure swing adsorption, Continuous crystallization

Module 5: chromatographic techniques

Elution Chromatography-Principles, retention theory, Principle and applications of Ion exchange chromatography, Affinity chromatography, Hydrophobic interaction chromatography, Gel filtration chromatography, Membrane chromatography, Affinity monolith chromatography, supercritical fluid chromatography, gas chromatography, chiral chromatography.

Text Books

1. Kaushik Nath, Membrane Separation Processes, PHI Learning Pvt. Ltd,
2. S.B. Thakore & B.I Bhatt, Introduction to process Engineering & Design, Tata McGraw-Hill Ltd.,2007
3. Marcel Mulder, Basic Principles of Membrane Technology, 2/e, Kluwer Academic Publishers,1996

Reference Books

1. Richard W Baker, Membrane Technology and Applications, John Wiley & Sons Ltd, 2004.
2. Seader J D, Ernest J Henley, Separation Process Principles, Wiley New York, 1998
3. Phillip C Wankat, Separation Process Engineering, 2/e, Pearson Education, 2007.
4. King, C.J., Separation Processes, Tata McGraw – Hill Publishing Co., Ltd. (1982).
5. Osadar, V., and Nakagawa, I., Membrane Science and Technology, Marcel Dekkar (1992).
6. Schoew, H.M., New Chemical Engineering Separation Techniques, Interscience Publishers (1972).
7. Kestory, R.E., Synthetic Polymeric Membranes, Wiley (1987).

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**An overview of membrane separation process**	
1.1	Membrane separation-classification of membrane separation processes	1
1.2	dead end and cross flow filtration	1
1.3	ultrafiltration, microfiltration	1
1.4	nanofiltration, reverse osmosis,	1
1.5	dialysis, electrodialysis,	1
1.6	pervaporation, advantages and disadvantages	1
1.7	Applications of membrane separation process	1
2	**Membrane materials, structure, and preparation techniques**	
2.1	Types of membranes,	1
2.2	characteristics of membrane pore structures-pore size, pore size distribution, pore density and surface roughness,	1
2.3	permeability and membrane resistance	1
2.4	membrane preparation methods	1
2.5	membrane modules-plate and frame, tubular, spiral wound, hollow fiber and capillary module, and their relative merits and demerits.	2
3	**Transport mechanisms in membranes**	
3.1	Driving forces for transport mechanisms,	1
3.2	transmembrane flux, retention factor or separation factor, selectivity, factors affecting retentivity,	1
3.3	concentration polarization, gel polarization,	2
3.4	fouling, cleaning and regeneration of membranes, turbulence enhancers	1
3.5	membrane separation models-Irreversible thermodynamics, Capillary flow theory, Solution diffusion model, Viscous flow models.	2
4	**Non-conventional separation processes**	
4.1	Principle, applications, advantages and disadvantages of Azeotropic and Extractive distillation	1
4.2	Reactive distillation, Membrane distillation,	1
4.3	Reactive extraction, Cloud point extraction, Supercritical fluid extraction	2
4.4	Separation using surfactants,	1
4.5	Field Flow Fractionation/Gradient Separation,	1
4.6	Pressure swing adsorption.	1
4.7	Continuous crystallization	1
5	**Chromatographic techniques**	
5.1	Elution Chromatography-Principles, retention theory	1
5.2	Principle and applications of Ion exchange chromatography, Affinity chromatography,	1

5.3	Hydrophobic interaction chromatography, Gel filtration chromatography	1
5.4	Membrane chromatography, Affinity monolith chromatography.	2
5.5	Supercritical fluid chromatography, gas chromatography, chiral chromatography.	2
	Total lecture hours	**35**

BTT436	BIOMATERIALS , TISSUE ENGINEERING & STEM CELLS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: To acquire elementary awareness of the principles and applications of the multidisciplinary fields of biomaterials science and tissue engineering.

Pre-requisite: Nil

Course Outcomes:

CO1	Understand the properties, uses and limitations of materials and devices to repair, replace or augment living tissues and organs of the human body.
CO2	Assimilate the key biological and engineering principles underlying biomaterials science and tissue engineering.
CO3	Examine the scientific, technological, social and ethical issues involved in the clinical implementation of tissue engineering.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	2											
CO2	3											
CO3	2					3		3				

Assessment Pattern

Bloom's category	Continuous assessment tests		End semester examination
	1	2	
Remember	20	20	40
Understand	30	30	60
Apply			
Analyze			
Evaluate			
Create			

Marks distribution

Total marks	CIE	ESE	ESE duration
150	50	100	3 hours

Continuous internal evaluation pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub- divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Discuss the effects of fabrication on strength of metallic biomaterials, with suitable examples.
2. Outline the common techniques used in the manufacture of ceramic biomaterials.

Course Outcome 2 (CO2):

1. Elaborate on the need for and the strategies used to control the 3D architecture of scaffold materials used in tissue engineering applications.
2. Discuss the key considerations in the choice of a biomaterial as scaffold for fabrication of tissue engineered constructs.

Course Outcome 3 (CO3):

1. Discuss the major ethical constraints associated with stem cell applications in tissue engineering context.
2. Summarize the major scientific challenges and technological barriers involved in construction of bio-artificial hybrid organs for transplantation.

Model Question Paper

		Total pages:
Reg No:	**Name:**	
	APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY **THIRD SEMESTER B.TECH DEGREE EXAMINATION ____________, 20____**	
	Course Code: BTT 436	
	Course Name: BIOMATERIALS, TISSUE ENGINEERING AND STEM CELLS	
Max Marks: 100		**Duration: 3 Hours**
	Part A	
	Answer all questions. Each carries 3 marks.	
1	Discuss contact angle methods for surface characterization of materials.	(3)
2	Define fatigue and toughness of solid materials.	(3)
3	Discuss the properties and biomedical applications of PMMA.	(3)
4	Elaborate on degradable hydrogels prepared from natural materials.	(3)
5	Explain the mechanism of adult wound healing.	(3)
6	Discuss the role of soluble signals in the coordination of cell-fate processes.	(3)
7	Describe the salient features and applications of bioactive glass scaffolds.	(3)
8	Explain the use of embryonic stem cells in regenerative medicine, with an example.	(3)
9	Summarize the strategy for repair of damaged cartilage through tissue engineering approach.	(3)
10	Discuss the major technological barriers involved in the development of tissue engineered constructs.	(3)
	Part- B	
	Answer any one full question from each module. Each carries 14 marks.	
11	Describe the common methods used for mechanical testing of biomaterials.	(14)
	Or	
12	Explain the common spectroscopic and microscopic techniques used for characterization of biomaterial surfaces.	(14)
13	Discuss the properties, applications and fabrication methods for various classes of composite materials used in medicine.	(14)
	Or	
14	Elaborate on the biotechnological aspects of collagen production, with respect to its use as a scaffold for tissue engineering applications.	(14)
15	Elaborate on morphogenetic processes and their implications in tissue engineering context.	(14)
	Or	
16	Describe the common immunological responses to transplanted foreign tissues and the mechanisms underlying graft rejection.	(14)
17	Explain the dynamic functions of stem cell systems, with a conceptual model for stem cell proliferative behavior.	(14)
	Or	
18	Discuss the key criteria for selection of a biomaterial for scaffold fabrication. Also explain the salient features and applications of various classes of scaffolds used in tissue engineering.	(14)
19	Elaborate on the application of tissue engineering principles in the repair of components of the musculo-skeletal system, with suitable case studies and/or examples.	(14)
	Or	

20	Explain the major scientific challenges in tissue engineering and the ethical issues connected with its clinical implementation.	(14)

Syllabus

Module 1: Properties of materials: Classification of materials**,** Primary and secondary interatomic bonds in solids; Mechanical properties of solids- elastic behavior, stress and strain, tension and compression, shear, elastic constants, Isotropy; Mechanical testing of materials; Fatigue and toughness; Effect of fabrication on strength of materials; Surface Properties of materials- Characterization of material surfaces, measurement techniques (Contact angle methods, ESCA, SIMS, SEM, STM, FTIR-ATR).
Metallic biomaterials: Stainless steels, CoCr alloys, Ti alloys and dental metals; Corrosion of metallic implants; Manufacturing of implants.
Bioceramics: Non-absorbable bioceramics, Biodegradable ceramics, bioactive ceramics; Deterioration of ceramics; Manufacturing techniques.

Module 2: Polymeric biomaterials: Polymerization and basic structure, effects of structural modification on properties, polymers used as biomaterials- PVC, polyethylene, PMMA, polystyrene, polyesters, polyamides, fluorocarbon polymers, rubbers, biodegradable polymers; Sterilization of polymers; Surface modifications for improving biocompatibility.
Composite biomaterials: Structure and properties; Anisotropy of composites; Particulate and fibrous composites, Porous materials; Biocompatibility aspects.
Biodegradable hydrogels: Hydrogel classifications-bulk-degrading covalently cross-linked hydrogels, degradable hydrogels derived from natural and synthetic materials.
Biologic biomaterials: Collagen- structure and properties, isolation and purification of collagen, matrix fabrication technology.

Module 3:Fundamentals of cell and tissue biology: Tissue organization- tissue components and tissue types; dynamic states of tissues- Homoeostasis and tissue repair- mechanism of wound healing; Morphogenetic processes; Cell fate processes- cell differentiation, migration, division and death; coordination of cell fate processes- soluble signals, cell-ECM interactions, cell-cell contact, interactions between signaling mechanisms; Angiogenesis; Basics of immune response- mechanisms of graft rejection.
Basics of cell and tissue culture: Types of tissue culture, cell lines, tissue culture media, characterization of cell function in tissue culture, cryopreservation.

Module 4: Scaffolds in tissue engineering: Criteria for an ideal scaffold; Potential scaffold materials- polymer scaffolds, bioactive ceramic scaffolds, bioactive glass scaffolds, composites; control of scaffold architecture.
Stem cell biology: Basic concepts- stem cell properties, telomeres and self-renewal, stem cell applications in tissue engineering; Examples for stem cell systems- Mesenchymal stem cells, Embryonic stem cells, neuronal stem cells etc. ; Dynamic function of stem cell systems- conceptual and dynamic models of stem-cell proliferative behavior

Module 5: Clinical applications of tissue engineering: Engineered skin substitutes, tissue engineered repair of damaged cartilage, skeletal tissue engineering, Bio-artificial organs- liver, pancreas and kidney. Scientific, technological and social challenges in tissue engineering; Regulatory constraints and ethical issues.

Textbooks:

1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons (eds.) *Biomaterials Science- An introduction to materials in medicine*, Academic Press, 1996.
2. Bernhard O. Palsson and Sangeeta N. Bhatia *Tissue Engineering*, Person, 2009.

Reference books:

1. Larry L. Hench and Julian R. Jones (eds.) *Biomaterials, Artificial organs and Tissue engineering*, Woodhead Publishing Limited, 2005.
2. Joyce Y. Wong and Joseph D. Bronzino(eds.) *Biomaterials*, CRC Press, 2007.
3. Robert Lanza, Robert Langer and Joseph Vacanti *Principles of Tissue Engineering*, 3rd edition, Academic press, 2007.
4. Robert Lanza (ed.) *Essentials of Stem Cell Biology*, 2nd edition, Academic Press, 2009.

Course Contents and Lecture Schedule

Module	Topic	Number of hours
1	Classification of materials; Primary and secondary interatomic bonds in solids	01
	Mechanical properties of solids- elastic behavior, stress and strain, tension and compression, shear, elastic constants, Isotropy	01
	Mechanical testing of materials; Fatigue and toughness; Effect of fabrication on strength of materials	01
	Surface Properties of materials- Characterization of material surfaces, measurement techniques (Contact angle methods, ESCA, SIMS, SEM, STM, FTIR-ATR).	01
	Metallic biomaterials: Stainless steels, CoCr alloys, Ti alloys and dental metals; Corrosion of metallic implants; Manufacturing of implants.	01
	Bioceramics: Non-absorbable bioceramics, Biodegradable ceramics, bioactive ceramics; Deterioration of ceramics; Manufacturing techniques.	01
2	**Polymeric biomaterials**: Polymerization and basic structure, effects of structural modification on properties, polymers used as biomaterials- PVC, polyethylene, PMMA, polystyrene, polyesters, polyamides, fluorocarbon polymers, rubbers, biodegradable polymers; Sterilization of polymers; Surface modifications for improving biocompatibility.	02
	Composite biomaterials: Structure and properties; Anisotropy of composites; Particulate and fibrous composites, Porous materials; Biocompatibility aspects.	02
	Biodegradable hydrogels: Hydrogel classifications-bulk-degrading covalently cross-linked hydrogels, degradable hydrogels derived from natural and synthetic materials.	02
	Biologic biomaterials: Collagen- structure and properties, isolation and purification of collagen, matrix fabrication technology.	02
3	Tissue organization- tissue components and tissue types	01
	Dynamic states of tissues- Homoeostasis and tissue repair- mechanism of wound healing	01
	Morphogenetic processes	01

	Cell fate processes- cell differentiation, migration, division and death	01
	Coordination of cell fate processes- soluble signals, cell-ECM interactions, cell-cell contact, interactions between signaling mechanisms	01
	Angiogenesis	01
	Basics of immune response- mechanisms of graft rejection.	01
	Types of tissue culture, cell lines, tissue culture media	01
	Characterization of cell function in tissue culture, cryopreservation.	02
4	**Scaffolds in tissue engineering**: Criteria for an ideal scaffold; Potential scaffold materials- polymer scaffolds, bioactive ceramic scaffolds, bioactive glass scaffolds, composites; control of scaffold architecture.	02
	Stem cell biology: Basic concepts- stem cell properties, telomeres and self-renewal, stem cell applications in tissue engineering	01
	Examples for stem cell systems- Mesenchymal stem cells, Embryonic stem cells, neuronal stem cells etc.	01
	Dynamic function of stem cell systems- conceptual and dynamic models of stem-cell proliferative behavior	01
5	**Clinical applications of tissue engineering:** Engineered skin substitutes, tissue engineered repair of damaged cartilage	01
	Skeletal tissue engineering	01
	Bio-artificial organs- liver, pancreas and kidney.	02
	Scientific, technological and social challenges in tissue engineering	01
	Regulatory constraints and ethical issues	01
	Total lecture hours	**35**

BTT446	BIOPROCESS INSTRUMENTATION	CATEGORY	L	T	P	CREDIT
		PEC	3	0	0	3

Preamble: Objective of this course is to provide knowledge in various instruments in a bioprocess industry. This course provides an overview of various operating principles of temperature and pressure measuring instrument. This course helps students to choose different analytical instruments and various biosensors used in day to day life It highlights the idea of fermentation software systems, data analysis and computer linked systems

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO 1	understand various characteristics of an instrument
CO 2	Extend the knowledge of understanding the various temperature sensors and pressure sensors in day to day life
CO 3	Describe the principle of analytical instruments and biochemical instrumentation used in biological applications
CO 4	Define the elements of digital computers and the components of a computer-controlled fermentation processes

Mapping of course outcomes with program outcomes

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO 1	3		2			2						
CO 2	3	2		2								
CO 3	2	2	2		2							
CO 4	2	2			2							2

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions (Minimum 3 questions per CO)

Course Outcome 1 (CO1): understand various characteristics of an instrument

1. Explain in detail on different performance characteristics of an instrument.
2. Elaborate with examples for some symbols and indications used in a P& I diagram
3. Illustrate the various functions carried out by instruments.

Course Outcome 2 (CO2) : Extend the knowledge of understanding the various temperature sensors and pressure sensors in day to day life

1. Illustrate the working of mercury-in-glass thermometer with a neat sketch.
2. Discuss the principle, construction, and operation of thermal conductivity gauge.
3. Differentiate between U tube manometer from inclined type manometer with their working principle.

Course Outcome 3(CO3): Describe the principle of analytical instruments and biochemical instrumentation used in biological applications

1. Explain the principle and working of NMR with a neat sketch.
2. State the working principle of glucose biosensor with a neat sketch
3. With a neat sketch, explain the different components of a biosensor.

Course Outcome 4 (CO4): Define the elements of digital computers and the components of a computer-controlled fermentation processes

1. Explain various components of a computer linked system.
2. Write short notes on : i) Data acquisition systems. ii) Operational strategies for batch bioprocess reactor.
3. Write short notes on fermentation software systems.

Model Question Paper

			Total Pages:

Reg No.:_______________		Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SVENTH/EIGHTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 446

Course Name: Bioprocess Instrumentation

Max. Marks: 100		Duration: 3 Hours

PART A

		Answer all questions, each carries 3 marks.
1.		Discuss on functioning elements of an instrument
2.		State the working principle of a transducer and represent the same with the help of a simple block diagram.
3.		Name any three temperature scales used in industries.
4.		Briefly describe positive displacement flowmeter
5.		Sketch and explain an instrument used for high pressure measurement.
6.		Discuss on the instrumentation of Bourdon Gauge.
7.		Justify the principle of biosensors. Give example.
8.		Comment on the working principle of electrophoretic technique.
9.		Explain in detail on various elements of digital computers.
10.		Write short notes on fermentation softwares used in industries

PART B

Answer any one full question from each module. Each carries 14 marks.

11.	a)	Explain in detail on different performance characteristics of an instrument?	(8)
	b)	Comment on any three biomedical applications of transducers with example.	(6)
		OR	
12.	a)	Distinguish between piezoelectric transducers and optical transducers.	(7)
	b)	Discuss the different symbols for instrumentation diagram.	(7)
13.	a)	Elaborate principle and working of two head flow meters.	(6)
	b)	Elaborate turbine type flow meters and mass flow meters.	(8)
		OR	
14.	a)	Sources of errors and precautions are to be taken in temperature measurements – Justify this statement.	(7)
	b)	Discuss the different types of thermocouples with its applicability ranges.	(7)
15.		Discuss the principle, construction and operation of hot cathode and cold cathode ionization gauges.	(14)
		OR	
16.	a	Name any two pressure measuring instruments in which elastic based transducers or sensors are used. Also mention their ranges of operation.	(14)
17.	a	Mention the steps involved in autoradiography.	(6)
	b	Give the idea behind Nuclear Magnetic Resonance Spectroscopy.	(8)
		OR	
18.	a)	Illustrate the instrumentation and working of HPLC with a neat diagram	(8)
	b)	Analyse the working of an amperometric biosensor with an example?	(6)

19.	a)	State the role of computer interfaces and peripheral devices in data analysis	(14)
		OR	
20.	a)	What do you mean by programmed batch bioreaction? Give example.	(8)
	b)	Analyse the need of data smoothing in data analysis.	(6)
		****	

Syllabus:

Module 1: Introduction to bioprocess instrumentation- Definition of instrumentation. Functional elements and functions of an instrument- Classification of instruments- Static and Dynamic Characteristics of measuring instruments Transducers their principles and working, different types of transducers – Piezoelectric transducers, electromagnetic transducers, optical transducers , transducers for biomedical applications – Instrumentation Diagram

Module 2: Methods for measuring process variables – Temperature measurements, temperature scales, basic principles and working of thermometers, mercury in glass thermometer , thermocouples , Range of different types of temperature measuring instruments Sources of errors and precautions to be taken in temperature measurement

Flow measurements: Head flow meters, area flow meters, positive displacement flow meters , mass and magnetic flow meters and strain gauges .

Module 3: Pressure Measurement : principle of working of manometers Various types of manometers- McLoed Guage, Knudsen gauge , bellows, diaphragms , Electrical pressure measurement , Piezoelectric manometers, Thermal conductivity gauges – Ionisation gauge high pressure measurement

Module 4: Analytical Instruments: Chromatography: GC, HPLC

Spectroscopy: Mass Spectroscopy, NMR, Audioradiography, Electrophoresis, Schematic summary of biochemical reactor Instrumentation

Biosensors- Various components of biosensors- potentiometric biosensors- calorimetric, optical, Amperometric, conductometric biosensors, Biosensors for glucose, alcohol and BOD

Module 5: Elements of digital computers- Computer Interfaces and Peripheral Devices Data Analysis- Data Smoothing and interpolation- State and parameter estimation

Components of Computer Linked System- Programmed Batch Bioreaction-Design and Operation strategies for batch plants- Fermentation Software systems

Text Books

1) R K Jain ,*Mechanical and Industrial Measurements* , Khanna Publishers
2) Eckmann D P, *Industrial Instrumentation*, Wiley Eastern Limited, 1975

Reference Books

1) Alok Barua, *Fundamentals of Industrial Fermentation*, Wiley India Pvt Ltd, 2011
2) Patranabis D, *Principles of Industrial Fermentation*, Tata Mcgraw-Hill Education, 2001
3) Peter F Stanbury, Allan Whitaker, Stephen J Hall, *Principles of Fermentation Technology*.3/e, Butterworth-Heinemann, 2016

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Introduction to bioprocess instrumentation**	
1.1	Definition of instrumentation	**1**
1.2	Functional elements and functions of an instrument	
1.3	Classification of instruments	
1.4	Static and Dynamic Characteristics of measuring instruments	**1**
1.5	Transducers their principles and working	**1**
1.6	Different types of transducers – Piezoelectric transducers, electromagnetic transducers, optical transducers	**1**
1.7	Transducers for biomedical applications	**1**
1.8	Instrumentation Diagram	**1**
2	**Methods for measuring process variables**	
2.1	Temperature measurements, temperature scales	**1**
2.2	Basic principles and working of thermometers	
2.3	Mercury in glass thermometer	
2.4	Thermocouples, range of different types of temperature measuring instruments	**1**
2.5	Sources of errors and precautions to be taken in temperature measurement	**1**
	Flow measurements:	
2.6	Head flow meters, area flow meters	**1**
2.7	Positive displacement flow meters	**1**
2.8	Mass and magnetic flow meters	**1**
2.9	Strain gauges	**1**
3	**Pressure Measurement**	
3.1	Principle of working of manometers	**1**
	Various types of manometers	
3.2	McLoed Guage, Knudsen guage	**1**
3.3	Bellows, diaphragms	
	Electrical pressure measurement	
3.4	Piezoelectric manometers	**1**
3.5	Thermal conductivity gauges	**1**
3.6	Ionisation guage	**1**
3.7	High pressure measurement	**1**
4	**Analytical Instruments: Chromatography**	
4.1	GC, HPLC	**1**
	Spectroscopy	
4.2	Mass Spectroscopy, NMR	**1**
4.3	Audioradiography	**1**
4.4	Electrophoresis	**1**
4.5	Schematic summary of biochemical reactor Instrumentation	**1**
	Biosensors-	
4.6	Various components of biosensors	**1**
4.7	Potentiometric biosensors, calorimetric, optical biosensors	**1**
4.8	Amperometric biosensors	**1**
4.9	Conductometric biosensors	**1**
4.10	Biosensors for glucose, alcohol, and BOD	**1**

5	**Elements of digital computers-**	
5.1	Computer Interfaces and Peripheral Devices	**1**
5.2	Data Analysis- data Smoothing and interpolation	**1**
5.3	State and parameter estimation	**1**
	Components of Computer Linked System	
5.4	Programmed Batch Bioreaction	**1**
5.5	Design and Operation strategies for batch plants	**1**
5.6	Fermentation Software systems	**1**
	Total lecture hours	**35**

BTT456	DRUG DESIGN AND DEVELOPMENT	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:

- To introduce the basic concepts of drug discovery , the types of diseases & causes
- To provide a fundamental knowledge on the traditional approaches in drug discovery and validation
- To give an insight to computer aided drug discovery and molecular modelling methods.

Prerequisite: Basic knowledge of molecular biology , biochemistry & chemistry

Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the history of drug discovery the types of diseases & causes
CO 2	Explain the traditional approaches in drug discovery, pipeline and clinical trials
CO 3	Explain computer aided discovery, docking software usage
CO 4	Explain the importance of molecular modelling in the drug discovery
CO 5	Describe the importance of personalised medicine and role of regulatory bodies

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2		1			2						
CO 2	3											
CO 3	2		2			2		1				
CO 4	3	2	3		2	3	3					3
CO5	2	2	2		2			2				2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions (Minimum 3 questions per CO)

Course Outcome 1 (CO1): Understand the history of drug discovery the types of diseases & causes

1. History of Drug Discovery, story of aspirin
2. Types of diseases and their causes,
3. Germ theory, molecular basis of disease
4. Characteristics of a drug compound, Mechanisms of drug action.

Course Outcome 2 (CO2) : Explain the traditional approaches in drug discovery, pipeline and clinical trials

1. Traditional approaches in drug discovery,
2. Concept of Molecular targets, COX2, EGFR and HIV Protease.
3. Drug discovery pipeline
4. ADME, pre-clinical trials and clinical trials.

Course Outcome 3(CO3): Explain computer aided discovery, docking software usage

1. Computer aided drug discovery- Target based and ligand-based approaches-
2. Concept of QSAR;
3. Molecular docking- Genetic and Monte Carlo algorithms;
4. Docking software- ArgusLab, AutoDock.

Course Outcome 4 (CO4): Explain the importance of molecular modelling in the drug discovery

1. Molecular modelling in drug discovery.
2. Combinatorial libraries.
3. Target structure modelling, active site characterisation.
4. Molecular dynamics simulations in drug discovery.

Course Outcome 5 (CO5):Describe the importance of personalised medicine and role of regulatory bodies

1. Future of therapeutics: Personalised medicine
2. Pharmacogenomics.
3. Pharmaceutical industry and development of drugs; Economics and regulatory aspects;
4. Ethical issues related to drug discovery.

Model Question Paper

			Total Pages:
Reg No.:_______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SVENTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 456

Course Name: Drug Design and Development

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	Comment on small molecular drugs.
2.	Give the characteristics of a drug compound.
3.	Define ADME.
4.	Write a note on COX2.
5.	Comment on the parameters used in QSAR studies.
6.	List out an brief on the algorithms used in molecular docking
7.	Summarise the factors involved in active site characterisation.
8.	Give the role of combinatorial libraries in drug discovery
9.	What are personalised medicines?
10.	Define the term Pharmacogenomics.

PART B

Answer any one full question from each module. Each carries 14 marks.

	Module 1	
11.	Discuss in detail the Mechanism of Drug action.	(14)
	OR	
12.	Classify and explain the drug compound.	(14)
	Module 2	
13.	Elaborate on the molecular drug targets.	(14)
	OR	
14.	Discuss in detail the drug discovery pipeline.	(14)
	Module 3	
15.	Explain the importance and functioning of any two Docking softwares.	(14)
	OR	
16.	Discuss the concept of target- ligand based approaches in CADD.	(14)
	Module 4	
17.	Brief on the importance of target structure modelling and active site characterisation in Drug discovery.	(14)
	OR	
18.	Write a note on the molecular dynamics simulation in drug discovery.	(14)
	Module 5	
19.	Elaborate on the role of regulatory bodies in Drug discovery process.	(14)
	OR	
20.	Explain in detail the Economics and the ethical issues associated with drug discovery.	(14)

****

Syllabus

Module 1:

History of Drug Discovery, story of aspirin: Review of basic biological concepts, Types of diseases and their causes, Germ theory, molecular basis of diseases. Characteristics of a drug compound, small molecular drugs, peptide drugs, sources of drugs - plant, animals, microbes and minerals. Mechanisms of drug action.

Module2:

Traditional approaches in drug discovery, Drug discovery in post - genomic era, high throughput screening. Concept of Molecular targets, Examples of targets- COX2, EGFR and HIV Protease. Drug discovery pipeline-target identification, validation, lead identification, optimisation, ADME, pre-clinical trials and clinical trials.

Module3:

Computer aided drug discovery- Target based and ligand-based approaches- Virtual screening, de novo drug design, pharmacophore. Concept of QSAR; molecular descriptors, 3D QSAR. Molecular docking- search algorithms and scoring functions- Genetic and Monte Carlo algorithms; empirical and knowledge-based scoring. Docking software- ArgusLab, AutoDock**.**

Module4:

Molecular modelling in drug discovery. Combinatorial libraries. Target structure modelling, active site characterisation. Molecular surfaces- solvent accessible surface, polar surface etc. Free energy of binding; concept of Energy, forcefields, energy minimisation. Molecular dynamics simulations in drug discovery.

Module5:

Future of therapeutics: Personalised medicine and Pharmacogenomics. Pharmaceutical industry and development of drugs; Economics and regulatory aspects; Quality management. FDA and other regulatory bodies. Indian patent laws. Patent amendment act and its implications. Ethical issues related to drug discovery.

Reference Books

1. Kristian Stromgaad, Povl Korgsgaard- Larsen, Ulf Madsen,Textbook on drug design and discovery, 5th edition, Taylor and Francis Group, 2017
2. Benjamin E. Blass, Basic Principles of Drug Discovery andDevelopment, 2nd edition, Academic Press,2021
3. Dev Buksh Singh, Computer- Aided Drug Design- Springer, 2020
4. Claude Cohen N, Guide book on Molecular Modelling, Academic Press, 1996

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module I : Basics of Bioinformatics**	
1.1	History of Drug Discovery, story of aspirin: Review of basic biological concepts	1
1.2	Types of diseases and their causes,	1
1.3	Germ theory, molecular basis of diseases.	1
1.4	Characteristics of a drug compound, small molecular drugs, peptide drugs,	2
1.5	sources of drugs-plant, animals, microbes and minerals.	2
1.6	Mechanisms of drug action.	2
2	**Module II:**	
2.1	Traditional approaches in drug discovery,	2
2.2	Drug discovery in post - genomic era, high throughput screening.	2
2.3	Concept of Molecular targets, Examples of targets- COX2, EGFR and HIV Protease.	3
2.4	Drug discovery pipeline- target identification, validation, lead identification, optimisation,	1
2.5	ADME, pre-clinical trials and clinical trials.	1
3	**Module III:**	
3.1	Computer aided drug discovery- Target based and ligand-based approaches- Virtual screening, de novo drug design, pharmacophore.	2
3.2	Concept of QSAR; molecular descriptors, 3D QSAR.	1
3.3	Molecular docking- search algorithms and scoring functions-	1
3.4	Genetic and Monte Carlo algorithms; empirical and knowledge-based scoring.	1
3.5	Docking software- ArgusLab, AutoDock.	1
4	**Module IV:**	
4.1	Molecular modelling in drug discovery. Combinatorial libraries.	1
4.2	Target structure modelling, active site characterisation.	1
4.3	Molecular surfaces- solvent accessible surface, polar surface etc.	1
4.4	Free energy of binding; concept of Energy, forcefields, energy minimisation.	1
4.5	Molecular dynamics simulations in drug discovery.	1
5	**Module V : Drug Design**	
5.1	Future of therapeutics: Personalised medicine and Pharmacogenomics.	1
5.2	Pharmaceutical industry and development of drugs; Economics and regulatory aspects;	1
5.3	Quality management.	1
5.4	FDA and other regulatory bodies.	1
5.5	Indian patent laws. Patent amendment act and its implications.	1
5.6	Ethical issues related to drug discovery.	1
	Total lecture hours	**35**

CODE	CLINICAL RESEARCH AND DRUG TESTING	CATEGORY	L	T	P	CREDIT
BTT466		PEC	2	1	0	3

Preamble: Should have the knowledge on the basic concepts of Biochemistry

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Introduction and History of Clinical research
CO 2	Drug Regulations & Ethics in Clinical Research, Background of ethics
CO 3	Clinical Trial Documentation, Audits and Inspections
CO 4	Introduction to Clinical Data Management
CO 5	Types of drug testing, important techniques used in drug testing

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-				3	3				
CO 2	-	-	-					3				
CO 3	-	-	3	3								
CO 4	-	3	-	3								
CO 5	-	-	-				3	3				

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 no.) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Introduction and history of clinical research and different phases of clinical research studies

1. Clinical research trials
2. Drug discovery and drug development
3. Different phases of clinical trials

Course Outcome 2 (CO2): Ethics for clinical research.

1. Drug regulations
2. Ethics in clinical research.
3. Drug regulations in India
4. Drug prices in India and Clinical trial registry in India

Course Outcome 3(CO3): Clinical trial documentation

1. Clinical trial documentation
2. Role of personnel in clinical trials
3. Clinical research organization

Course Outcome 4 (CO4): Introduction to clinical research data management

1. Introduction to data management system.
2. Medical coding / writing
3. Pharmacovigilance

Course Outcome 5 (CO5): Drug testing and important techniques used for drug testing

1. Various methods of drug testing.
2. Important techniques used for drug testing.

Model question paper

			Total Pages:
Reg No.:______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGTH SEMESTER B. TECH DEGREE EXAMINATION___20__

Course Code: BTT466

Course Name: CLINICAL RESEARCH AND DRUG TESTING

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	Write any three important terminologies used in clinical trials.
2.	Mention different phases of clinical research.
3.	Explain five principles of research ethics
4.	Explain Indian GCP?
5.	Role of Clinical research audit
6.	Explain role of clinical research organizations
7.	Role of clinical data management
8.	Write short note on CDM
9.	Explain various types drug testing?
10.	List the major techniques used in drug testing.

PART B

Answer any one full question from each module. Each carry 14 marks.

11.	(a)	Explain CPCSEA Guidelines.	(7)
	(b)	Write a short on toxicology studies in clinical research?	(7)
		OR	
12.	(a)	Explain different phases of clinical research.	(7)
	(b)	Briefly explain E-clinical trials?	(7)
13.	(a)	Nuremberg code research ethics in clinical research.	(8)
	(b)	Explain schedule Y in clinical research.	(6)
		OR	
14.	(a)	Role CTRI-Clinical trial registry of India?	(8)
	(b)	Write a short note consent Process in clinical research.	(6)
15.	(a)	Different types of Audits and Inspections in clinical research Explain trial	(7)
	(b)	design in clinical research.	(7)
		OR	
16.	(a)	What are the major responsibilities of Principal Investigator in clinical research?	(8)

	(b)	Importance of Clinical Research Organization.	(6)
17.	(a) (b)	Role of clinical data manager in clinical data management. General principles of clinical data management.	(7) (7)
		OR	
18.	(a)	Explain important tools for clinical data management systems. Briefly explain how is medical coding done?	(7) (7)
19.	(a) (b)	Explain various types drug testing? List out important techniques used for the drug testing and explain any one of the drug testing techniques in detail.	(5) (9)
		OR	
20.	(a) (b)	Explain X-ray diffraction study in drug testing? Define radioimmunoassay and methods of radioimmunoassay?	(7) (7)
		****	

Syllabus

An exposure is giving students in: The History and introduction to Clinical research and drug testing. understand drug regulation and ethics in clinical research, to study importance of clinical trial documentation, different types of clinical trials, role clinical research organizations, introduction to clinical data management system, various types of drug testing systems and important techniques used in drug testing.

Module 1: Introduction and History of Clinical research, Clinical Trial Terminologies, CPCSEA Guideline & Pre-clinical Trials, Introduction to Toxicity Studies, Drug Discovery & Development, Definition of clinical trial, Different Phases of clinical research, Sub-types of Phase 1,2 and 3, Phase 4, Bio-availability & Bio-equivalence Studies [BA/BE], E –clinical trial.

Module 2: Drug Regulations & Ethics in Clinical Research, Background of ethics, Nuremberg code, Declaration of Helsinki, Belmont Report, Informed consent Process, History of Indian regulations, Schedule–Y-Appendices, ICMR Guidelines, Indian GCP, ICH GCP, Drugs & magic remedies Act 1954, Drug prices control order, Regulations for AYUSH, CTRI-Clinical trial registry of India.

Module 3: Clinical Trial Documentation, Audits and Inspections, Different types of trial design, Clinical trial documents, Role of personnel in a clinical trial, Definition & responsibility of Principal Investigator, Objective and Role of Clinical Research Organization, Site Management and Monitoring in Clinical Research

Module 4:: An Introduction to Clinical Data Management, Data Management Standards, Set-Up, CDMS & CTMS, Conduct, Medical coding / Writing, Close Out, Pharmacovigilance.

Module 5: Types of drug testing: oral, urine, blood, hair, perspiration, and breathalyzers. Techniques used for Drug Testing. UV and visible spectrophotometry, Fluorimetry, IR spectrophotometry, NMR, 13c NMR, Mass Spectrometry, Flame Photometry, Emission Spectroscopy, Atomic Absorption Spectroscopy, X -ray Diffraction, Radio immunoassay, GC, GC-MS, IRMS.

Text Books

1. Clinical Research Coordinator Handbook, Fourth edition, Norris, Deborrah Plexus Pub
2. Drug testing 1st edition, John Fay
3. Handbook of drug monitoring methods therapeutic and drug abuse, Amitava Dasgupta, Humana Press publishers.
4. Practical guide of clinical data management, Third edition, Susanne Prokscha, Taylor and Francis Inc

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	**Module I**	
1.1	Introduction and History of Clinical research,	1
1.2	Clinical Trial Terminologies, CPCSEA Guideline & Pre-clinical Trials,	1
1.3	Introduction to Toxicity Studies	1
1.4	Drug Discovery & Development	1
1.5	Definition of clinical trial	
1.6	Different Phases of clinical research	1
1.7	Sub-types of Phase 1,2 and 3, Phase 4	1
1.8	Bio-availability & Bio-equivalence Studies [BA/BE]	1
1.9	E –clinical trial.	
2	**Module II**	
2.1	Drug Regulations & Ethics in Clinical Research, Background of ethics	1
2.2	Nuremberg code, Declaration of Helsinki, Belmont Report,	1
2.3	Informed consent Process, History of Indian regulations	1
2.4	Schedule–Y-Appendices, ICMR Guidelines	1
2.5	Indian GCP, ICH GCP	
2.6	Drugs & magic remedies Act 1954	1
2.7	Drug prices control order	1
2.8	Regulations for AYUSH,	1
2.9	CTRI-Clinical trial registry of India	
3	**Module III**	
3.1	Clinical Trial Documentation	1
3.2	Audits and Inspections,	1
3.3	Different types of trial design	1
3.4	Role of personal in clinical trial, Clinical trial documents	1
3.5	**Definition & responsibility of Principal Investigator**	1
3.6	**Objective and Role of Clinical Research Organization**	1
3.7	Site Management and Monitoring in Clinical Research	1
4	**Module IV**	
4.1	An Introduction to Clinical Data Management	1
4.2	Data Management Standards	2
4.3	Conduct, Medical coding / Writing, Close Out,	1

4.4	Pharmacovigilance	2
5	**Module V**	
5.1	Types of drug testing: oral, urine, blood, hair, perspiration, and breathalyzers.	2
5.2	Techniques used for Drug Testing. UV and visible spectrophotometry	1
5.3	IR spectrophotometry, NMR, 13c NMR	1
5.4	Flame Photometry, Emission Spectroscopy,	1
5.5	X -ray Diffraction,	1
5.6	Radio immunoassay	1
5.7	GC, GC-MS, IRMS	1
	Total lecture hours	**35**

PROGRAM ELECTIVE V

BTT418	PROCESS SAFETY AND BIOETHICS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Understand the basic concepts of safety procedures carried out in process plants and the ethical perspective of handling biomaterials

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Be aware of rules and regulations setup at international level for various biotechnology related work so that any further research can be formulated accordingly.
CO 2	Know the social and legal status of society with respect to genetically engineered products and other outcomes of biotechnology.
CO 3	Identify the potential hazards and hazardous conditions associated with the processes and equipment involved in process industries.
CO 4	Work according to the safety precautions set up by international bodies while handling bio hazardous material.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	2	3	3	-	-	-	-
CO2	-	-	-	-	-	3	3	3	-	-	-	-
CO3	-	-	-	-	-	3	3	-	-	-	-	-
CO4	-	-	-	-	-	3	3	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Be aware of rules and regulations setup at international level for various biotechnology related work so that any further research can be formulated accordingly.

1. Explain the various DBT guidelines on Biosafety?
2. What are the benefits of GLP?
3. Explain about Cartagene Protocol

Course Outcome 2 (CO2): Know the social and legal state of the society with respect to genetically engineered products or other outcomes of biotechnology

1. Illustrate various risks associated with GM crops and how it is assessed?
2. Explain some of the ethical issues pertaining to genetic engineering
3. Illustrate safety guidelines for r-DNA research

Course Outcome 3(CO3): Identify the potential hazards and hazardous conditions associated with the processes and equipment involved in process industries

1. Write the significance of safety audit
2. Write examples for chemical hazards? Which are the safety measures to reduce these hazards?
3. Explain about fire protection methods which are used in process plants.

Course Outcome 4 (CO4): Work according to the safety precautions set up by international bodies while handling bio hazardous material.

1. Explain in detail the different Biosafety levels and the protocols for each
2. Write about the ethical aspects of prenatal testing
3. What is GURT?

Model Question Paper

			Total Pages:
Reg No.:______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION_20__

Course Code: BTT 418

Course Name: PROCESS SAFETY AND BIOETHICS

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.	Define ‘hazard’, write any two examples
2.	What is ‘LD_{50}’and ‘LC_{50}’
3.	What is BLEVE?
4.	Write the difference between flash and fire points
5.	Identify any two specific biological hazard
6.	Differentiate partial barrier and absolute barrier equipments
7.	How are the potential risks to human health determined?
8.	How the pathogenic organisms are classified?
9.	What is an orphan drug? Give examples
10.	What are transgenic plants?

PART B

Answer any one full question from each module. Each carries 14 marks.

11.	With the help of neat diagram, explain the working of any two safety equipments used in chemical industry	(14)
	OR	
12.	Illustrate hazard identification techniques	(14)
13.	Write in detail about fire protection and prevention in industries	(14)
	OR	
14.	Illustrate Event Tree and Fault Tree analysis with examples	(14)
15.	Illustrate different Biosafety levels	(14)
	OR	
16.	Demonstrate Biosafety guidelines and regulations in India	(14)
17.	Explain about cartagene protocol	(14)
	OR	
18.	What are genetically modified (GM) organisms and GM foods? Why GM foods produced and what are are their benefits?	(14)
19.	Ethical Aspects of Designer Babies and genetic screening	(14)
	OR	

20.		With the help of a case study, explain ethical issues in pharmaceutical drug research	(14)
		****	

Syllabus

Module 1: Overview of process safety. Components of safety. Safety audit. Accident investigation and reporting. Safety education and training. Chemical hazards, Toxic chemicals-dusts, gases, fumes, mists, vapors and smoke. Exposure evaluation. The concept of threshold limit, chronic and acute exposure effects. Safety equipments in chemical plants– working principles. Safety in chemical reactions and storage and explosive or flammable dust, gases, vapours etc. Identification of hazards.

Module 2: Chemistry of fire, composition of combustion – flame, heat, fire, gases, smoke, ignition temperature, LFL – UFL-Flash point, Fire point. Spontaneous combustion. Classification of fires, flammability principles. Fire prevention, Fire protection in process plants. Fire and Explosion rating of process plants. Introduction to the modeling of fire explosion and toxic gas dispersion, pool fire, torch, BLEVE. HAZOP and HAZAN. Event probability and failure frequency analysis (Fault and Event Tree analysis). Designing for safety, emergency planning and disaster management.

Module 3: Biosafety guidelines and regulations, FAO, USDA & DBT guidelines on Biosafety. Containment of equipment and apparatus in biotechnology industry and research, Good laboratory Practices. Biosafety levels- Containment in BSL-1, BSL -2, BSL-3, BSL-4 levels, design requirements and standard microbiological laboratory practices in each level. Design for Good Laboratory Practices, Waste disposal, shipping transportation and treatment of bio-hazardous materials and waste products. Decontamination of industrial and laboratory wastes:- agents, selection and methods for decontamination.

Module 4: Hazards of genetic engineering, bio-safety for human health and environment, social and ethical issues pertaining to genetic engineering, bio-safety in relation to transgenic research, r- DNA guidelines and applications. Bio-safety and cartagene protocol, Environmental monitoring of GM crops and organisms. Risk assessment of GM organisms and crops released into the environment.

Module 5: Biotechnology and Bioethics. Ethical biotechnology (Rights, Confidentiality, Animal Rights, Environmental Ethics, Decision Making) – Ethical Aspects of Designer Babies, genetic screening and prenatal testing – issues of ethics in biomedicine. Transgenic plants. The debates of GM foods. Terminator technology, Ethical, issues of the Human Genome Project. Ethical issues in pharmaceutical drug research. Orphan drugs.

Text Books

1. Chemical Process Safety Fundamentals with Applications by Daniel A. Crowl and Joseph F Louvar, Prentice Hall, 3rd editiion,2002.
2. Daniel A. Crowl and J. F. Louvar, Chemical Process Safety, Fundamentals with Applications, 3rd ed., Prentice Hall, 2011. 723 pages. ISBN-13: 978-0-13-138226-8

Reference Books

1. Hazop & Hazan by Trevor A. Kletz., I.ChemE, 2nd edition, 2001
2. F.P Lease: *Loss prevention in Process plants worth*, London
3. G.L Wells: *Safety in Process Plant Design*, IChem E/ Godwin
4. *Comprehensive Bio technology* Vol IV, Murray Moov –Young.
5. D.A Shapton and R.G Board: *Safety in microbiology*, Academic Press London.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1.1	Overview of process safety. Components of safety. Safety audit	2
1.2	Accident investigation and reporting. Safety education and training	1
1.3	Chemical hazards, Toxic chemicals-dusts, gases, fumes, mists, vapors and smoke. Exposure evaluation. The concept of threshold limit, chronic and acute exposure effects	2
1.4	Safety equipments in chemical plants– working principles. Safety in chemical reactions and storage and explosive or flammable dust, gases, vapours etc. Identification of hazards.	2
2.1	Chemistry of fire, composition of combustion – flame, heat, fire, gases, smoke, ignition temperature, LFL – UFL-Flash point, Fire point. Spontaneous combustion	2
2.2	Classification of fires, flammability principles. Fire prevention, Fire protection in process plants. Fire and Explosion rating of process plants	2
2.3	Introduction to the modeling of fire explosion and toxic gas dispersion, pool fire, torch, BLEVE.	2
2.4	HAZOP and HAZAN. Event probability and failure frequency analysis (Fault and Event Tree analysis). Designing for safety, emergency planning and disaster management.	2
3.1	Biosafety guidelines and regulations, FAO, USDA & DBT guidelines on Biosafety. Containment of equipment and apparatus in biotechnology industry and research, Good laboratory Practices	2
3.2	Biosafety levels- Containment in BSL-1, BSL -2, BSL-3, BSL-4 levels, design requirements and standard microbiological laboratory practices in each level	2
3.3	Design for Good Laboratory Practices, Waste disposal, shipping transportation and treatment of bio-hazardous materials and waste products.	2
3.4	Decontamination of industrial and laboratory wastes: - agents, selection and methods for decontamination.	2
4.1	Hazards of genetic engineering, bio-safety for human health and environment, social and ethical issues pertaining to genetic engineering	2
4.2	Bio-safety in relation to transgenic research, r- DNA guidelines and applications.	1
4.3	Bio-safety and cartagene protocol, Environmental monitoring of GM crops and organisms.	2
4.4	Risk assessment of GM organisms and crops released into the environment.	1
5.1	Biotechnology and Bioethics. Ethical biotechnology (Rights, Confidentiality, Animal Rights, Environmental Ethics, Decision Making)	2
5.2	Ethical Aspects of Designer Babies, genetic screening and prenatal testing – issues of ethics in biomedicine	2

5.3	Transgenic plants. The debates of GM foods. Terminator technology, Ethical, issues of the Human Genome Project. Ethical issues in pharmaceutical drug research. Orphan drugs.	2
	Total lecture hours	**35**

BTT428	BIOBUSINESS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:

Research and business belong together and both are needed for the strong economic growth of our country. In a rapidly developing biotechnology industry, there is an urgent need for people who combine business knowledge with the understanding of science & technology. Biobusiness, is an interdisciplinary course, which revolves around the central theme of how to manage and develop life science companies and projects.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify the scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies
CO 2	Understand the various management and legal documentation needed in biotechnological venture creation, such as project reports, company incorporation and contract drafting
CO 3	Analyse and shortlist projects in various biotechnology sectors with the help of case studies of such start ups.
CO 4	Gain an understanding of the various regulatory mechanisms for biotechnology research and the risk assessment of these products along with the ethical aspects related to their production and sale.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	1	1	2	2	3	3
CO 2	-	-	-	-	-	-	-	-	3	3	3	1
CO 3	-	-	-	-	-	2	-	1	1	1	1	3
CO 4	-	-	-	-	-	3	3	3	-	-	1	2

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions(Minimum 3 questions per CO)

Course Outcome 1 (CO1): Identify the scope for entrepreneurship in biosciences and utilize the schemes promoted through knowledge centres and various agencies

1. Discuss the growth of the Biotech Industry in India over the last three years and analyze the various high growth areas .
2. What are the various funding opportunities available for a startup in India.
3. Which are the Biotech Hubs in India and illustrate their importance.

Course Outcome 2 (CO2): Understand the various management and legal documentation needed in biotechnological venture creation, such as project reports, company incorporation and contract drafting.

1. What are the benefits of drafting Project report for the introduction of a new biotechnology product into the market.?
2. Discuss the salient points in Contract law in India.
3. What are the benefits and drawbacks of incorporating a partnership, Limited Liability Partnership and a Private Limited company in India.

Course Outcome 3(CO3): Analyse and shortlist projects in various biotechnology sectors with the help of case studies of such start ups.

1. What are the opportunities available in contract research for biopharmaceuticals in India.
2. Analyze the reasons for the failure of the billion dollar startup Theranos.in the US.
3. Discuss the reasons why India is the largest generic drug manufacturer in the world..

Course Outcome 4 (CO4): Gain an understanding of the various regulatory mechanisms for biotechnology research and the risk assessment of these products along with the ethical aspects related to their production and sale.

1. Discuss the importance of the FSSAI Act in the food processing sector in India..
2. What are ethical issues to be considered for GURT technologies in India?
3. What are the guidelines to be followed while introducing a Genetically modified product into the India market.

Model Question Paper

			Total Pages:

Reg No.:_______________ Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 428

Course Name: BIOBUSINESS

Max. Marks: 100 Duration: 3 Hour

PART A

Answer all questions, each carries 3 marks.

1.		What is the full form of DBT and how does it support biotech research in India.
2.		What are some of the Threats facing the Biotech sector in India.
3.		Describe any one option available for initial funding of your new Biotech product.
4.		Enumerate any three difficulties faced in marketing biopharmaceuticals.
5.		What are the benefits of taking your proof of concept product to a business technology incubator? Name any one TBI suitable for biotechnology products.
6.		Write a note on any one popular Biotech park in India.
7.		Give any 3 guidelines formulated by the Planning Commission for Project report preparation.
8.		What are the 3 requirements for patent filing and what is the patent term in India.
9.		What is the full form of AYUSH and what products does it regulate?
10.		What is the difference between a rational and a subjective perception of risk.

PART B

Answer any one full question from each module. Each carries 14 marks.

11.	a)	Enumerate and elaborate on some of the opportunities of contract research in the biotechnology sector in India for the global market.	(7)
	b)	What are the various opportunities afforded by BIRAC for biotechnology entrepreneurs in India? Elaborate,	(7)
		OR	
12.	a)	What are the benefits of patenting for high cost biopharmaceutical drug research?	(7)
	b)	Discuss the economic state of the Indian Biotechnology Industry in 2021-22 and what was the role and contribution of biopharmaceuticals towards this growth..	(7)
13.	a)	You have developed a new oral drug for controlling sugar levels. Discuss the means you would use to choose your launch market, entry and marketing strategy, product pricing and long term growth prospects. Defend your answers.	(14)
		OR	
14.	a)	Discuss the salient points to be followed in drawing up a joint venture agreement with a research agency for product manufacture and marketing.	(7)
	b)	*"Venture Capital Funding is the preferred route for new age biotechnology products and services to get initial funding instead of conventional banks"*. Do you agree or disagree with the statement? Support your answer with reasons.	(7)

15.		With a suitable case study and example highlight the opportunities available in India for vaccine production in India with reference to the COVID-19 global pandemic. Your answer should mention the major players, the market size and a SWOT analysis of the same.	(14)
		OR	
16.		With the help of a suitable example highlight the requirement, scope, marketing strategy and challenges faced with the introduction of a biotechnology product that would help in the Bioremediation of industrial pollutants in India.	(14)
17.	a)	What is a project report and discuss on the important components to be included in a project report.	(7)
	b)	Why does one undertake a Feasibility Study? Explain what you mean by Technical Feasibility Study; Financial Feasibility Study and Social Feasibility Study.	(7)
		OR	
18.	a)	What are the benefits and drawbacks of Technology leasing, licensing and transfer instead of having one's own Research and Development centre.	(6)
	b)	Analyze the reasons for the monumental rise and the dramatic failure of the celebrated billion dollar startup Theranos in the US.	(8)
19.	a)	What are the some of the major ethical concerns to be addressed while undertaking genetic research and how does the government regulate this.	(14)
		OR	
20.	a)	What are the protocols that need to be followed for GMO manufacture and research in India based on the risk factors.	(7)
	b)	Discuss the role of global regulatory bodies such as FDA and the EU in the generic drug manufacturing sector in India.	(7)

Syllabus

Module 1:

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities for innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Module 2:

Negotiating the road from lab to the market (strategies and processes of negotiation with financers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills

Module 3:

Business opportunity, Essential requirement, marketing strategies, schemes, challenges and scope-with case study- Pollution monitoring and Bioremediation for Industrial pollutants, Pesticides, Herbicides etc. I Fermented products-probiotic and prebiotics. Stem cell production, stem cell bank, contract research. Production of monoclonal/polyclonal antibodies, Single cell protein and secondary metabolite production. Contact research in microbial genomics. Building Biotech business challenges in Indian context-biotech partners (BICEPS,BIRAC,DBT, Incubation centers. Etc.,), operational biotech parks in India.

Module 4:

Indian Company act for Bio business-schemes and subsidies. Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study. Patent expiry and Entrepreneurship opportunity, Principles of Technology leasing, licensing and transfer, Startup schemes in Indian government, Business incubation support schemes, Successful start-upscase study. Failed global Biotech case study : Theranos..

Module 5:

Regulatory affairs in Bio business-regulatory bodies and their regulations (ex.FDA, EU, DSIR, AYUSH, FSSAI etc.,) Public education of the process of biotechnology involved in generating new forms of life for informed decision-making. Ethical concerns of biotechnology research and innovation-Interference with nature fear of unknown, unequal distribution of risks. Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards.

Text Books:

1. Adams, D. J., & Sparrow, J. C. (2008). Enterprise for Life Scientists: Developing Innovation and Entrepreneurship in the Biosciences. Bloxham: Scion.
2. Shimasaki, C. D. (2014). Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Amsterdam: Elsevier. Academic Press is an imprint
3. Jordan, J. F. (2014). Innovation, Commercialization, and Start-Ups in Life Sciences. London: CRC Press.
4. Desai, V. (2009). The Dynamics of Entrepreneurial Development and Management. New Delhi: Himalaya Pub. House.

Reference Books / Sources

1. Biospectrum India –ABLE Industry Survey- https://www.biospectrumindia.com
2. Yali Friedman (2014) , Building Biotechnology: Biotechnology Business, Regulations, Patents, Law, Policy, ISBN-13: 978-1934899298; ISBN-10: 193489929
3. Rajeev Roy , "Entrepreneurship", Third Edition, Oxford University Press. 2020
4. Biotech Consortium India Limited (BCIL) : https://www.biotech.co.in/en

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1.1	Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms:	2
1.2	Factors shaping opportunities for innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities,	2
1.3	Alternatives faced by emerging bio-firms and the relevant tools for strategic decision,	1
1.4	Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India	2
1.5	Strategic dimensions of patenting & commercialization strategies.	1
2.1	Negotiating the road from lab to the market (strategies and processes of negotiation with financers, government and regulatory authorities),	2
2.2	Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs),	2
2.3	Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements	2
2.4	Dispute resolution skills	1
3.1	Business opportunity, Essential requirement, marketing strategies, schemes,	2
3.2	Challenges and scope-with case study- Pollution monitoring and Bioremediation for Industrial pollutants, Pesticides, Herbicides etc. I	1
3.3	Fermented products-probiotic and prebiotics. Stem cell production, stem cell bank, contract research.	1
3.4	Production of monoclonal/polyclona antibodies, Single cell protein and secondary metabolite production. Contact research in microbial genomics.	2
3.5	Building Biotech business challenges in Indian context-biotech partners (BICEPS,BIRAC,DBT, Incubation centers. Etc.,), operational biotech parks in India.	2
4.1	Indian Company act for Bio business-schemes and subsidies. Meaning of Project; Project Identification; Project Selection;	1
4.2	Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal.	2
4.3	Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study	2
4.4	Patent expiry and Entrepreneurship opportunity, Principles of Technology	1

	leasing, licensing and transfer, Startup schemes in Indian government, Business incubation support schemes,	
4.5	Successful start-ups case study / Failed global Biotech case study : Theranos	1
5.1	Regulatory affairs in Bio business-regulatory bodies and their regulations (ex.FDA, EU, DSIR, AYUSH, FSSAI etc.,)	2
5.2	Public education of the process of biotechnology involved in generating new forms of life for informed decision-making.	1
5.3	Ethical concerns of biotechnology research and innovation-Interference with nature fear of unknown, unequal distribution of risks.	2
5.4	Rational vs. subjective perceptions of risks and benefits, relationship between risk, hazard, exposure and safeguards.	2
	Total lecture hours	**37**

BTT438	ENTREPRENEURSHIP & IPR	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble:

Rapid progress in Biotechnology and development of innovative products and services with no prior parallels has led to the importance of Intellectual Property Rights for protecting such knowledge and entrepreneurship for introducing such products. This course provides a broad coverage of the elements of Entrepreneurship and IPR enabling students to understand the fundamentals in these two important areas.

Prerequisite: None

Course Outcomes: After the completion of the course the student will be able to

CO 1	To understand the fundamental aspects of Entrepreneurship and introduce him to available funding methods for enabling startups.
CO 2	Explain and differentiate between the different types of Intellectual Property Rights and their appropriate usage
CO 3	Understand the requirements of patenting and the procedure for patent filing under the Indian Patent Law
CO 4	Assess the importance of patenting in the biotechnological field and its implications with respect to traditional knowledge, genetically modified organisms and plants varieties.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	2	-	1	3	2	3	2
CO 2	-	-	-	-	-	-	-	-	-	2	2	1
CO 3	-	-	-	-	-	1	-	1	2	3	2	3
CO 4	-	-	-	-	-	3	3	3	1	3	2	1

Assessment Pattern

Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination**
	1	**2**	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	**CIE**	**ESE**	**ESE Duration**
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions(Minimum 3 questions per CO)

Course Outcome 1 (CO1): To understand the fundamental aspects of Entrepreneurship and introduce him to available funding methods for enabling startups.

1. What are some of the traits that a successful entrepreneur is often seen to have?
2. Using an example of an Indian tech company discuss the development of Bangalore as a Computer Technology hub in India.
3. What are the various funding opportunities available for a startup in India.

Course Outcome 2 (CO2): Explain and differentiate between the different types of Intellectual Property Rights and their appropriate usage

1. What are the seven types of Intellectual Property Rights that are to be legislated by every signatory of the WTO?
2. What is the relevance and importance of IPRs in the Knowledge economy today.
3. Differentiate between Patents, Trade secrets and Industrial Design and with examples explain when would you use each of them

Course Outcome 3(CO3): Understand the requirements of patenting and the procedure for patent filing under the Indian Patent Law

1. What are the three important criteria for filing a patent. Explain each with an example.
2. What is the difference between complete and provisional patents in India and discuss the benefits and drawbacks of each.
3. What is the timeline and costs of filing a patent in India.

Course Outcome 4 (CO4): Assess the importance of patenting in the biotechnological field and its implications with respect to traditional knowledge, genetically modified organisms and plants varieties.

1. Discuss the importance of the Traditional Knowledge Digital Library in preventing biopiracy of Indian Traditional Knowledge?
2. What are GURT technologies and how do they affect farmers in India?
3. Describe the mechanism formulated by the GEAC for regulating GMO introduction in India

Model Question Paper

			Total Pages:

Reg No.:_______________		Name:__________________________

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__

Course Code: BTT 438

Course Name: ENTREPRENEURSHIP AND IPR

Max. Marks: 100		Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

1.		What is the difference between an intrapreneur and entrepreneur?
2.		Name any three types of Entrepreneurs and their role in society.
3.		Describe any one method used for detecting entrepreneurial traits.
4.		What is the relevance and importance of Technology Incubators in Entrepreneurship ?
5.		What are the three agreements that form the foundation of the WTO.
6.		What is the difference between WIPO and WTO with respect to IPR governance?
7.		Why are patent fees initially kept low in India by the Government?
8.		What is a provisional patent application and what are the advantages of filing one
9.		Why is an IDA essential for biotechnology patenting under the Budapest treaty?
10.		What is the difference between Biopiracy and Bioprospecting. Give examples

PART B

Answer any one full question from each module. Each carries 14 marks.

11.	a)	Describe the ways in which entrepreneurship can lead to the economic development of a country.	(7)
	b)	What are the various guidelines given by the Planning Commission for formulating project reports	(7)
		OR	
12.	a)	How does one develop the various entrepreneurial competencies?	(7)
	b)	What is a project report and discuss on the important components to be included in a project report.	(7)
13.	a)	Discuss the steps you would follow to choose a suitable entrepreneurial project	(7)
	b)	Using a suitable Indian business case study, show the rapid rise of the Biotechnology Industry over the last decade in India.	(7)
		OR	
14.	a)	What .are the specific traits that a successful entrepreneur should inculcate?	(7)
	b)	*"Venture Capital Funding is the preferred route for new age technology products and services to get initial funding instead of conventional banks"*. Do you agree or disagree with the statement? Support your answer with reasons.	(7)
15.		With suitable examples explain the seven types of IPR mandated to be followed by all signatories to the WTO	(14)
		OR	
16.		With a help of a time line show the historical development of IPR	(14)

		agreements from the Paris Agreement to the present day TRIPS. Explain the reasons of why the WTO had to be formed and the inclusion of the TRIPS agreement under it inspite of the WIPO being already there.	
17.	a)	Differentiate between Trade Secrets and Patents and explain when you would use each of these.	(7)
	b)	What is the difference between “pre-grant” and “post-grant” opposition and discuss the benefits of India following this patent process?	(7)
		OR	
18.	a)	Differentiate between the Novelty criteria and the Non Obviousness criteria for patent filing and explain the reason why one needs to use a “person skilled in the art” to evaluate inventiveness.	(6)
	b)	With a neat flow sheet describe patent filing process for an individual in India with the approximate costs incurred.	(8)
19.	a)	What do you understand by biopiracy and highlight it with the NEEM case study and the development of the TKDL.	(14)
		OR	
20.	a)	What are the reasons that India decided to go for its own treaty PPVFR instead of following the UPOV treaty that was in existence. Explain the main points for the PPVFR treaty.	(7)
	b)	Discuss the DiamonD VS Chakrabarty case and its impact on biological patenting.	(7)
		****	

Syllabus

Module 1:

Entrepreneurship: Definition, functions and kinds of entrepreneurs, intrapreneur-entrepreneurship and economic development, entrepreneurial competencies-, developing competencies, project identification, selection and financing. Project report-content and significance, Planning Commission's guidelines for formulating project reports-methods of project appraisals.

Module 2:

Traits of an entrepreneur, tools for detecting entrepreneurial traits - Thematic Apperception Test (TAT), Inkblot test, Case studies - successful entrepreneurs in India and abroad, Innovation - generating project ideas, interaction with research institutions, Technology-Business incubators, Project financing - financing schemes for different types of entrepreneurs. Start –ups, venture capital funding and IPO.

Module 3:

Introduction to intellectual property rights (IPR): Concept of IPR, Need for IPR, The Genesis and historical development of IPR, .Paris Agreement, Madrid Agreement , Hague Agreement, Role of WIPO and its evolution. Formation of the WTO and its global role. The GATT, GATS and TRIPS Agreements. Seven types of IPR recognized as per the TRIPS Agreement. Trademarks, Trade secrets, Geographical Indications, Copyright, Patents , Industrial Design and IC Design. Summary of each with timelines and examples.

Module 4:

Patents. Types of Patents. Requirements of a patent. Novelty, Utility and Non obviousness. Concept of prior-art, person skilled in the art. Patent search. National and international patent databases. United States Patent and Trademark Office (USPTO), European Patent Office (EPO), PatentScope (WIPO), Patent cooperation treaty. Types of patent applications in India. Patenting procedures, time frame and cost,. Indian Patent Act 1970 & recent amendments.

Module 5:

Patenting of biological products, Factors justifying patentability of biotechnological inventions, Diamond VS Chakrabarty case. Budapest Treaty and IDAs. Problems in biotechnology patenting, Patenting of Traditional knowledge. Turmeric and Neem patent case Studies. Formation of the TKDL. Patenting of Plant varieties. UPOV treaties and relevance of the Protection of Pant varieties and Farmers Right Act in India. GURT and Terminator Technology. Protection of GMOs. Indian policy and safeguards for genetic research, role of GEAC. IP as a factor in biotechnology and pharmaceutical R&D.

Text Books:

1. Robert D Hisrich, Michael P Peters, & Dean A Shepherd, "Entrepreneurship", Tata McGraw Hill, 2007
2. Prabuddha Ganguli, "Intellectual Property Rights - Unleashing Knowledge Economy", Tata McGraw Hill, 2010
3. H.Koontz and Cyril O Donnell, "Essentials of Management", McGraw Hill, 2010.
4. R K Jain, Patents: Procedures and Practices, Universal Law Publishing, 2011,

Reference Books

1. C.B Gupta & S. Srinivasan, “Entrepreneurial Development”, S. Chand & Co., Limited New Delhi. 2005
2. R Radhakrishnan, S. Balasubramanian, “Intellectual Property Rights: Text and Cases”, Excel Books, New Delhi, 2008.
3. P Ganguli, “Gearing Up for Patents: The Indian Scenario”, Universities Press (India) Ltd., 1998.
4. Rajeev Roy , “Entrepreneurship”, Third Edition, Oxford University Press. 2020

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1.1	Definition, functions and kinds of entrepreneurs economic development,. -	1
1.2	Entrepreneurial competencies-traits, developing competencies, project identification, selection and financing	1
1.3	Project report-content and significance,	1
1.4	Planning Commission’s guidelines for formulating project reports	2
1.5	Methods of project appraisals	2
2.1	Traits of an entrepreneur, tools for detecting entrepreneurial traits - Thematic Apperception Test (TAT), Inkblot test,	1
2.2	Case studies - successful entrepreneurs in India and abroad, ,	2
2.3	Innovation - generating project ideas, interaction with research institutions, Technology-Business incubators	1
2.4	Project financing - financing schemes for different types of entrepreneurs.	2
2.5	Start –ups, venture capital funding and IPO.	1
3.1	Introduction to IPR Concepts, Need and Development of IPR	1
3.2	.Paris Agreement, Madrid Agreement , Hague Agreement, Role of WIPO and its evolution.	1
3.3	Formation of the WTO and its global role. The GATT, GATS and TRIPS Agreements	2
3.4	Trademarks, Trade secrets, Geographical Indications,	1
3.5	Copyright, Industrial Design and IC Design	1
3.6	Patents	1
4.1	Types of Patents. Requirements of a patent. Novelty, Utility and Non obviousness.	1
4.2	Concept of prior-art, paerson skilled in the art. Patent search. National and international patent databases.	2
4.3	United States Patent and Trademark Office (USPTO), European Patent Office (EPO), PatentScope (WIPO),.	1
4.4	Patent cooperation treaty. Types of patent applications in India. Patenting procedures, time frame and cost,.	2
4.5	Indian Patent Act 1970 & recent amendments	1

5.1	Factors justifying patentability of biotechnological inventions, Diamond VS Chakrabarty case. Budapest Treaty and IDAs	1
5.2	Problems in biotechnology patenting, Patenting of Traditional knowledge. Turmeric and Neem patent case Studies. Formation of the TKDL	2
5.3	UPOV treaties and Farmers Right Act in India. GURT and Terminator Technology. Protection of GMOs	2
5.4	Indian policy and safeguards for genetic research, role of GEAC.	1
5.5	IP as a factor in biotechnology and pharmaceutical R&D. .	1
	Total lecture hours	**35**

BTT448	BIOPHYSICS AND BIOSENSORS	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: Includes the concepts regarding the quantitative sciences of physics, maths and chemistry.
Prerequisite: NIL
Course Outcomes: After the completion of the course the student will be able to

CO 1	Understand the various areas of Biophysics
CO 2	Students should have excellent quantitative and analytical skills
CO 3	They must have an aptitude for Physics and Biology
CO 4	Understand the principles of Biosensors and its industrial applications, future scope of biosensors in the area of pollution monitoring industries.
CO 5	Imparting basic knowledge in interdisciplinary fields of Biophysics and Biosensors using modern tools to study and analyses biological data.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	2	2	-	-	-	-	-	-	-	-	-
CO 2	-	-	2	-	2	-	-	-	-	-	-	-
CO 3	-	2	-	2	-	-	-	-	-	-	-	-
CO 4	-	-	-	-	2	2	2	-	-	-	-	-
CO 5	-	-	-	-	2	2	2	-	-	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	20	20	40
Understand	20	20	40
Apply	10	10	20
Analyse			
Evaluate			
Create			

Mark distribution

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Level Assessment Questions

Course Outcome 1 (CO1): Understand the role of various Laws of Thermodynamics and Bioenergy molecules

1. Various laws of thermodynamics
2. Different types of Bioenergy molecules and stabilizing forces in Biomolecules

Course Outcome 2 (CO2): Structure and functions of Biomolecules, biomolecular interactions.

1. Structure and functions of DNA, polymorphism
2. Importance of Ramachandran plot, motifs and helices.
3. Various types of Biomolecules interactions

Course Outcome 3(CO3): Instrumentations in Biophysics

1. Types of instrumentations in Biophysics
2. Molecular Chaperones

Course Outcome 4 (CO4): Biosensors and its importance, applications and various types.

1. Measurement of pollution using biosensors and its application.
2. Advantages and limitations of Biosensors

Course Outcome 5 (CO5): Study various types of Biosensors and tis applications in various industries

1. Industrial uses of Biosensors such as Health care, Food and Environmental industries.
2. Design of Biosensors.

Model Question paper

			Total Pages:
Reg No.:______________		Name:__________________________	

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGTH SEMESTER B. TECH DEGREE EXAMINATION___20__

Course Code: BTT448

Course Name: BIOPHYSICS AND BIOSENSORS

Max. Marks: 100 | Duration: 3 Hours

PART A

Answer all questions, each carry 3 marks.

1.	Explain different laws of thermodynamics.
2.	Write a short note on various types of spectrophotometry.
3.	Explain structural properties of amino acids.
4.	Distinguish between B DNA and A DNA?
5.	List out various types of spectroscopies used for the study of biomolecules.
6.	Define circular dichroism.
7.	List out various components of Biosensors.
8.	Write short note on enzyme-based biosensor?
9.	Explain online monitoring of Biosensors?
10.	List the pros and cons of Biosensors used in Health care and food industry.

PART B

Answer any one full question from each module. Each carry 14 marks.

11.	(a)	Explain laws of thermodynamics?	(7)
	(b)	Write a short on entropy and write any example?	(7)
		OR	
12.	(a)	Explain nonpolar and polar interactions.	(7)
	(b)	Differentiate UV and visible spectrophotometry?	(7)
13.	(a)	Properties of amino acids.	(7)
	(b)	Motifs and domains in super secondary structure.	(7)
		OR	
14.	(a)	Role of Zinc finger proteins in health and disease?	(8)
	(b)	Write a short note on structure of Histone protein.	(6)
15.	(a)	Different types of spectroscopy techniques.	(7)
	(b)	Dynamic quenching properties of energy transfer in protein.	(7)
		OR	
16.	(a)	Molecular chaperon protein folding.	(8)
	(b)	Circular dichroism.	(6)

17.	(a)	Role biosensor in environmental monitoring?	(7)
	(b)	Different types of membrane Biosensors	(7)
		OR	
18.	(a)	Explain different types of Microorganisms used in Biosensors.	(7)
	(b)	Role of Various components of Biosensors?	(7)
19.	(a)	Biosensors in clinical chemistry?	(5)
	(b)	Explain biosensors used in diseases monitoring?	(9)
		OR	
20.	(a)	Biosensors used in soil condition monitoring?	(7)
	(b)	Explain various application in biosensors?	(7)
		****	

Syllabus

An exposure is giving students in: the bioenergetics of cell and the basic architecture of macromolecules. The interaction between macromolecules. To understand protein structure and functions, To study importance of Biosensors, role of biosensors in various industries. Pollution monitoring using biosensors. Role of various biosensors in various industries.

Module 1

Introduction to biophysical laws law of thermodynamics, the concept of enthalpy, entropy, and free energy, redox potential, High energy molecules ATP, ADP, GTP, NAD, NADP, FAD. Stabilizing forces in macromolecules, Ionic, covalent, H bonding Vander waals interaction polar and nonpolar interactions. Beer-Lambert law, light absorption and its transmittance. UV and visible spectrophotometry.

Module 2

Structure and functional groups, properties of amino acids structural implications of peptide bond, Ramachandran plot Motifs and domains, super secondary structure. Structure and polymorphism of DNA, A, B, Z and other forms DNA-Protein interactions, Interactions of transcription factors Leucine zipper, TBP, homeodomain and Various types of motifs. Histone DNA interaction, DNA drug interaction, RNA protein interactions, Protein drug interactions.

Module 3

Introduction to spectroscopy. Fluorescence spectroscopy, Static and dynamic quenching energy transfer Fluorescent probes in the study of proteins and nucleic acids, Infrared spectroscopy, light scattering in biology, Circular dichroism. Molecular chaperons

Module 4

Introduction to Biosensors- Advantages and limitations, various components of biosensors, Enzyme Biosensors. Biocatalysis based biosensors, Bioaffinity based biosensors & Microorganisms based biosensors, Biologically active material and analyte. Types of membranes used in biosensor constructions.

Module 5

Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food Low cost - biosensor for industrial processes for online monitoring; biosensors for environmental monitoring. Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare, food and environment.

Text Books

1. A text book of Biophysics R. N. Roy New Central Book Agency, 2001.
2. Smart Biosensor technology second edition George K Knopf, Amarjeet S Bassi CRC Press 2019
3. Donald G. Buerk - Biosensors Theory and Applications, First Edition Technomic Publishing. Co, Inc, 1993.
4. Elizabeth A Hall - Biosensors, First Edition, Open University, Milton Keynes, 1990.

Reference Books

1. Graham Ramsay - Commercial Biosensors, First edition, John Wiley & Sons, Inc. 1998.
2. Tran Minh Canh - Sensor Physics & Technology - Biosensors , First Edition, Champan & Hall, 1993.

Course Contents and Lecture Schedule

No	Topic	No. of Lectures
1	Introduction to biophysical laws law of thermodynamics	
1.1	The concept of enthalpy, entropy, and free energy, redox potential	1
1.2	High energy molecules	2
1.3	ATP, ADP, GTP NAD, NADP, FAD	
1.4	Stabilizing forces in macromolecules, Ionic, covalent, H bonding Vander waals interaction polar and nonpolar interactions	2
1.5	Beer-Lambert law, light absorption and its transmittance. UV and visible spectrophotometry.	1
2	Structure and functional groups, properties of amino acids structural implications of peptide bond	
2.1	Ramachandran plot Motifs and domains, super secondary structure.	1
2.2	Structure and polymorphism of DNA, A, B, Z and other forms	1
2.3	DNA-Protein interactions, Interactions of transcription factors Leucine zipper,	1
2.4	TBP, homeodomain	1
2.5	Various types of Protein motifs	1
2.6	Histone DNA interaction, DNA drug interaction, RNA protein interactions, Protein drug interactions.	2
3	Introduction to spectroscopy	
3.1	Fluorescence spectroscopy	1
3.2	Static and dynamic quenching energy transfer	1
3.3	Fluorescent probes in the study of proteins and nucleic acids	1
3.4	Infrared spectroscopy	1
3.5	Light scattering in biology	1
3.6	Circular dichroism. Molecular chaperons	1
4	Introduction to Biosensors	
4.1	Advantages	1
4.2	Limitations	
4.3	Various components of biosensors	1
4.4	Enzyme Biosensors	1
4.5	Biocatalysis based biosensors	1

4.6	Bioaffinity based biosensors	1
4.7	Microorganisms based biosensors	1
4.8	Biologically active material	1
4.9	Analyte	1
4.10	Types of membranes used in biosensor constructions.	1
5	Biosensors in clinical chemistry	
5.1	Medicine and health care	1
5.2	Biosensors for veterinary	2
5.3	Agriculture and food Low cost	
5.4	Biosensor for industrial processes for online monitoring	1
5.5	Application of enzymes in analysis	1
5.6	Design of enzyme electrodes and their application as biosensors in industry	2
5.7	Healthcare	
5.8	Food	
5.9	Environment.	
	Total lecture hours	**35**

BTT 458	BIOPROCESS QUALITY CONTROL	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: To introduce students to the quality control aspects of food and pharmaceutical industries and to familiarise the analytical methods to support process validation, quality control, quality standards and act.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain general considerations in quality of bioproducts
CO2	Explain quality assurance and quality management.
CO3	Explain the working principle and application of instruments used in process validation
CO4	Explain the food laws and regulations in India
CO5	Explain the need for biosafety and safe practices.

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2	2		1				
CO2	2						3	2			2	
CO3	2		3	2	2	2	2	2				
CO4	3											2
CO5	2		2					2				

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Mark distribution:

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks
Continuous Assessment Test (2 numbers) : 25 marks
Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 subdivisions and carry 14 marks.

Course Level Assessment Questions:

Course Outcome 1 (CO1): Explain general considerations in quality of bioproducts

1. General consideration in quality of food and pharmaceuticals
2. General principles of bioprocess validation

Course Outcome 2 (CO2):Explain quality assurance and quality management

1. Quality assurance and Quality management in the pharmaceutical industry.
2. General requirements of health regulatory bodies
3. Statistical quality controL

Course Outcome 3 (CO3):Explain the working principle and application of instruments used in process validation

1. Quality standards in food industry

Course Outcome 4 (CO4):Explain the food laws and regulations in India

1. Biosafety
2. Biological safety cabinets

Course Outcome 5 (CO5):Explain the need for biosafety and safe practices

1. Analytical methods for Bioprocess validation
2. Sterilization control and sterility testing

Model Question Paper

		Total Pages:
	Reg No.:	**Name:**
	APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY _________SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__	
	COURSE CODE:BTT458	
	COURSE NAME: BIOPROCESS QUALITY CONTROL	
Time: 3 hrs		**Total marks: 100**
	PART A	
1		Give the features of IP
2		Comment on the need of QC in food and pharmaceutical industry
3		Write the difference between GMP and cGMP
4		Give the Six sigma in quality control
5		List the importance of Codex Alimentarius Commission.
6		Give the objectives of AGMARK
7		State the important features of Material Safety Data sheet
8		Write a note on Primary and secondary contaminants.
9		Give the principle for NMR spectroscopy
10		What is meant by CIP
		PART B
11		Discuss the need for quality of bioproducts
12		List any two basic statistical tools for quality control.
		Or
13	**a**	Elaborate on the features of different Pharmacopeia in the world
	b	Explain the requirements and features of ISO 9000
		Or
14	**a**	Differentiate between quality control and quality assurance. Write the role of any four important quality considerations in the production of enzymes
	b	Explain any five salient features of Indian food safety and regulations act
		Or
15	**a**	List the benefits and objectives of a) BIS b)FPO c)PFA
	b	Comment on the role of the FSSAI in food safety.
16	**a**	Explain any four types of Biological safety cabinets
		Or
17	**a**	Describe the methods of safe handling and transport of biologicals
	b	Define biosafety also describe Biosafety levels of microorganism.
18	**a**	Explain the principle and use of IR spectrophotometer , SEM and Liquid scintillation spectrometry
		Or
19		Write the role of any four chemical disinfectants.
20		Explain C value, Z value and survival curve in sterilization.

Syllabus:

General consideration in quality of food and pharmaceuticals, Quality assurance and Quality management, general principles of bioprocess validation, analytical techniques used in process validation, sterilisation control, biosafety.

Module 1:
Need for quality control in food and pharmaceutical industries, general considerations in quality of bioproducts (e.g. enzymes, antibiotics, pharmaceuticals, recombinant products) such as molecular identity, potency, purity and stability, toxicity, immunogenecity and consistency. Brief introduction to IP, BP and USP, quality attributes.

Module 2:
Basic concepts of quality assurance: Quality assurance and Quality management in pharmaceutical industry. Requirements of GMP, cGMP, GLP, ISO 9000 series, Quality audits. Brief introduction to general requirements of health regulatory bodies such as US FDA, WHO. Statistical quality control, categories, quality control charts, Six Sigma quality control program, quality by design for biotech products

Module 3:
Quality standards-Salient features of Indian Food Safety regulations and acts, Food Laws and Regulations in India, Food Safety and Standards Act, 2006, Objectives, requirements and benefits of food grades and standards (BIS, AGMARK, PFA, FPO, CAC (Codex Alimantarious Commission), General Hygiene and Sanitation in food industry, Role of the FSSAI (The Food Safety and Standards Authority of India) in food safety.

Module 4:
Introduction to Biosafety, Need for biosafety, Basic methods for safe handling, transport, and storage of biological materials. Introduction to Biological safety cabinets Horizontal & Vertical Laminar Air Flow Cabinet, Fume hood, Primary and secondary containments; Containment levels, Biosafety levels of specific Microorganisms (food and water borne pathogens), Infectious Agents (Chemicals and carcinogens). MSDS-Material Safety Data Sheet Understanding. Biosafety policy in India.

Module 5:
Bioprocess Validation: General principles and practices, Analytical methods to support process validation-(Principle and applications only) - UV spectrophotometer, IR, FTIR, NMR, C-13 NMR, Mass spectra, Fluorescence and Atomic spectroscopy, Liquid scintillation spectrometry, Auto radiography, HPLC, HPTLC, gel chromatography, electrophoresis and ion-pair chromatography, GC-Mass, light, phase contrast, scanning and transmission electron microscopy, cytometry and flow cytometry. Thermogravimetry, Differential scanning calorimetry (DSC).
Sterilization control and sterility testing: batch and continuous heat sterilization, ultra high-temperature (UHT) processes, D value, z value, survival curve, Radiation, gaseous and filter sterilization, Chemical and biological indicators, Chemical disinfectants, clean-in-place (CIP) and sterilize-in-place (SIP) procedures, aseptic procedures necessary to achieve a sterile fermentation process.

Reference books:

1. Hans-Jurgen Bassler, Frank Lehmann, Containment Technology: Progress in the Pharmaceutical and Food Processing Industry, Springer, 2013.
2. World Health Organization (WHO), Quality Assurance of Pharmaceuticals: A Compendium of Guidelines, Volume 2.
3. Anurag S Rathore, Rohin Mhatre (Eds), Quality by Design for Biopharmaceuticals: Principles and Case Studies, Wiley, 2009.
4. Diane O Fleming, Debra A Long, Biological Safety: Principles and Practices, ASM Press, 4/e, 2006.
5. Quality Assurance of Pharmaceuticals: A Compendium of Guidelines, Volume 2, World Health Organization

Course contents and Lecture schedule		
No.	**Syllabus**	**No. of Lectures**
1.1	Need for quality control in food and pharmaceutical industries, general considerations in quality of bioproducts (e.g. enzymes, antibiotics, pharmaceuticals, recombinant products) such as molecular identity, potency, purity and stability, toxicity, immunogenecity and consistency. Brief introduction to IP, BP and USP, quality attributes.	**4**
2.1	Basic concepts of quality assurance: Quality assurance and Quality management in pharmaceutical industry. Requirements of GMP, cGMP, GLP, ISO 9000 series, Quality audits.	**4**
2.2	Brief introduction to general requirements of health regulatory bodies such as US FDA, WHO. Statistical quality control, categories, quality control charts, Six Sigma quality control program, quality by design for biotech products	**4**
3.1	Quality standards-Salient features of Indian Food Safety regulations and acts, Food Laws and Regulations in India, Food Safety and Standards Act, 2006, Objectives, requirements and	**4**
3.2	Benefits of food grades and standards (BIS, AGMARK, PFA, FPO, CAC (Codex Alimantarious Commission), General Hygiene and Sanitation in food industry, Role of the FSSAI (The Food Safety and Standards Authority of India) in food safety	**4**
4.1	Introduction to Biosafety, Need for biosafety, Basic methods for safe handling, transport, and storage of biological materials. Introduction to Biological safety cabinetsHorizontal & Vertical Laminar Air Flow Cabinet, Fume hood, Primary and secondary containments; Containment levels,	**4**
4.2	Biosafety levels of specific Microorganisms (food and water borne pathogens), Infectious Agents (Chemicals and carcinogens). MSDS-Material Safety Data Sheet Understanding. Biosafety policy in India.	**3**
5.1	Bioprocess Validation: General principles and practices, Analytical methods to support process validation-(***Principle and applications only***) of UV spectrophotometer, IR, FTIR, NMR, C-13 NMR, Mass spectra, Fluorescence and Atomic spectroscopy, Liquid scintillation spectrometry, Auto radiography, HPLC, HPTLC, gel chromatography, electrophoresis and ion-pair chromatography, GC-Mass, light, phase contrast, scanning and transmission electron microscopy, cytometry and flow cytometry. Thermogravimetry, Differential scanning calorimetry (DSC).	**4**
5.2	Sterilization control and sterility testing: (***Principle and applications only***) batch and continuous heat sterilization, ultra high-temperature (UHT) processes, D value, z value, survival curve, Radiation, gaseous and filter sterilization.Chemical and biological indicators, Chemical disinfectants, clean-in-place (CIP) and sterilize-in-place (SIP) procedures, aseptic procedures necessary to achieve a sterile fermentation process	**4**
	Total lecture hours	**35**

BTT 468	Modelling and Scale up of Bioreactors	CATEGORY	L	T	P	CREDIT
		PEC	2	1	0	3

Preamble: To provide an overview of modeling and outline its applications in the engineering design, optimization and scale-up of bioreactor systems.

Prerequisite: BTT201, BTT205, BTT202, BTT206

Course Outcomes: After the completion of the course the student will be able to

CO1	Outline the basic principles of modeling and its implications in the design and optimization of bioreactor systems and processes.
CO2	Illustrate the key information required for developing a coherent model for a bioreactor system.
CO3	Identify the tools required for modeling of a bioreactor system
CO4	Summarize the basic concepts and approaches pertinent to scale-up of bioreactor systems

Mapping of course outcomes with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		2	2							
CO2	3	2		2	2							
CO3	3	2		2	2							
CO4	3	2		2	2							

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination
	1	2	
Remember	10	10	10
Understand	20	20	20
Apply	20	20	70
Analyse			
Evaluate			
Create			

Marks distribution:

Total Marks	CIE	ESE	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern:

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 15 marks

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 subdivisions and carry 14marks.

Course Level Assessment Questions:

Course Outcome 1 (CO1): Outline the basic principles of modeling and its implications in the design and optimization of bioreactor systems and processes.

1. Classification of models.
2. Implications of modeling in reactor design

Course Outcome 2 (CO2): Illustrate the key information required for developing a coherent model for a bioreactor system.

1. Physical and biological information required for bioreactor modelling
2. General principles of mass transfer, mixing and reaction in relationship with modelling.

Course Outcome 3 (CO3): Identify the tools required for modeling of a bioreactor system

1. Mass and energy balance equations
2. Models for tank type and tubular bioreactors

Course Outcome 4 (CO4): Summarize the basic concepts and approaches pertinent to scale-up of bioreactor systems

1. Scale-up problems
2. Criteria and approaches to scale-up of bioreactors

Model Question Paper

			Total Pages:
Reg No.:		**Name:**	
	APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY _________SEMESTER B. TECH DEGREE EXAMINATION ________ ____ 20__		
	COURSE CODE: BTT468		
	COURSE NAME: MODELING AND SCALE UP OF BIOREACTORS		
Time: 3 hrs		**Marks:100**	
	PART A		
	Answer all questions. Each question carries 3 marks.		
1.		Distinguish between mathematical and verbal models.	3
2.		Illustrate the general procedure for modelling.	3
3.		Distinguish between steady and unsteady state mass balances.	3
4.		Write the model equations relevant to plug flow and stirred tank reactors.	3
5.		Distinguish between micromixing and macromixing.	3
6.		Discuss the concept of characteristic mixing time.	3
7.		Illustrate the steps for oxygen transfer in an immobilized cell system.	3
8.		Explain the concept of stagnant film in gas-liquid mass transfer	3
9.		List the common scale-up methods based on constant operating variables.	3
10.		Explain scale-down procedure with an example.	3
		PART B	
		Answer any one full question from each module. Each question carries 14 marks.	
11.		Elaborate the major interactions between cells and their physical environment. Also explain how this could impact the modelling of a bioreactor system.	14
		OR	
12.		Elaborate on lumped and distributed parameter models with suitable examples.	14
13.		Illustrate energy balancing in a continuous stirred tank reactor	14
		OR	
14.		Outline the model for a tubular bioreactor based on steady state mass balancing.	14
15.		Discuss the implications of mixing and aeration in biochemical reactions. Also explain how the effects of mixing could be incorporated into models for simple stirred tank reactor systems.	14
		OR	
16.		Explain the modelling of imperfectly mixed reactors with suitable examples.	14
17.		Explain the general oxygen balances for gas-liquid mass transfer phenomena.	14
		OR	
18.		Elaborate on effectiveness factor and its relevance in heterogenous reaction systems.	14
19.		Discuss the concept of time constants in the context of regime analysis in bioreactors.	14
		OR	
20.		Elaborate on the common criteria and methods used for scale-up of bioreactors for aerobic fermentation processes.	14

Syllabus:

Definition and classification of models, benefits and applications of modeling, general modelling procedure, tools for bioreactor modeling – mass and energy balances, models for stirred tank and tubular plug flow reactors, mixing-bioreaction interactions, mass transfer in bioreactors, General principles of scale-up- scale up criteria, method and approaches.

Module 1:

Modeling basics: Definition of a model, advantages of modeling, classification of models- physical, mathematical and verbal models; variables and parameters in a model, process models- Lumped and distributed parameter models, complexity of the model, parameter sensitivity- Use of models for design and optimization of bioreactors-general modeling procedure. Physical and biological information for bioreactor modeling- Interrelations between cells and their physical/chemical environment.

Module 2:

Tools for bioreactor modeling: Formulation of general and partial material balance equations- Types of mass balance equations, balancing procedure, total mass balances, component balances for reacting systems- Simple stoichiometry, elemental balancing, mass and energy yield coefficients- Energy balancing for bioreactors. General balances for tank-type biological reactors- Batch, continuous and fed-batch; Modeling of tubular plug-flow reactors- steady and unsteady state balancing.

Module 3:

Analysis of mixing-bioreaction interactions: Characterization of mixing- concentration distribution, concentration field, macromixing and micromixing, rate of mixing, mixing mechanisms, characteristic mixing times, contribution of aeration to macromixing. Reaction characteristic time, competition between mixing and biological reaction, analysis and modeling of couplings between mixing and bioreaction- modeling of non-perfectly mixed bioreactors.

Module 4:

Mass transfer in biological reactors: Interphase gas-liquid mass transfer, general oxygen balances for gas-liquid transfer and its applications, models for oxygen transfer in large-scale bioreactors.

Diffusion and biological reaction in immobilized biocatalyst systems: External mass transfer, internal diffusion and reaction- finite difference model, dimensionless parameters, effectiveness factor concept.

Module 5:

Scale-up of bioreactors: Scale-up problems, scale up methods in use, scale up based on constant operating variables, environmental approach, scale down approach, regime analysis-time constants for transport phenomena and conversion.

Reference books:

1. I.J. Dunn, E.Heinzle, J.Ingham, J.E. Prenosil Biological Reaction Engineering- Dynamic modeling fundamentals with simulation examples, Second edition (2003), Wiley- VCH.
2. A.Fiechter (ed.) Bioprocess Parameter Control in Advances in Biochemical Engineering/Biotechnology Vol.30 (1984), Springer- Verlag.
3. Jerome Morchain Bioreactor Modeling- Interactions between hydrodynamics and biology (2017) ISTE Press, Elsevier.

4. Nicolaas Marius Gerard Oosterhuis Scale-up of Bioreactors: a scale down approach (1984), Huisdrukkerij Suiker Unie

Course contents and Lecture schedule

No.	Syllabus	No. of Lectures
1.1	**Modeling basics**: Definition of a model, advantages of modeling, classification of models- physical, mathematical and verbal models; variables and parameters in a model, process models- Lumped and distributed parameter models, complexity of the model, parameter sensitivity- Use of models for design and optimization of bioreactors-general modeling procedure. Physical and biological information for bioreactor modeling- Interrelations between cells and their physical/chemical environment.	**7**
2.1	**Tools for bioreactor modeling**: Formulation of general and partial material balance equations- Types of mass balance equations, balancing procedure, total mass balances, component balances for reacting systems- Simple stoichiometry, elemental balancing, mass and energy yield coefficients- Energy balancing for bioreactors. General balances for tank-type biological reactors- Batch, continuous and fed-batch; Modeling of tubular plug-flow reactors- steady and unsteady state balancing.	**7**
3.1	**Analysis of mixing-bioreaction interactions**: Characterization of mixing-concentration distribution, concentration field, macromixing and micromixing, rate of mixing, mixing mechanisms, characteristic mixing times, contribution of aeration to macromixing. Reaction characteristic time, competition between mixing and biological reaction, analysis and modeling of couplings between mixing and bioreaction- modeling of non-perfectly mixed bioreactors.	**7**
4.1	**Mass transfer in biological reactors**: Interphase gas-liquid mass transfer, general oxygen balances for gas-liquid transfer and its applications, models for oxygen transfer in large-scale bioreactors.	**3**
4.2	**Diffusion and biological reaction in immobilized biocatalyst systems**: External mass transfer, internal diffusion and reaction- finite difference model, dimensionless parameters, effectiveness factor concept.	**4**
5.1	**Scale-up of bioreactors**: Scale-up problems, scale up methods in use, scale up based on constant operating variables, environmental approach, scale down approach, regime analysis-time constants for transport phenomena and conversion.	**7**
	Total lecture hours	**35**

BTT404	COMPREHENSIVE COURSE VIVA	Category	L	T	P	Credit	Year of Introduction
		PCC	1	0	0	1	2019

Preamble:
This course will provide an opportunity to strengthen the knowledge acquired by the students in the core courses studied during the B.Tech degree. This will enable the students to become successful in competitive examinations and inspire them to take up suitable employment in Biotechnology/Bioprocessing/Process Engineering industries as process engineers or researchers.
.
Pre-requisite: Biotechnology Engineering or Biochemical Engineering Core Courses

Course outcomes: After the course, the student will able to:

CO1	Examine the knowledge acquired in the core courses in Biotechnology Engineering/Biotechnology & Biochemical Engineering degree.
CO2	Develop confidence to appear for any competitive and/or other examinations and to face interviews.
CO3	Communicate the views clearly and precisely with anyone in scholarly environments
CO4	Apply the comprehensive knowledge gained in core courses in understanding engineering problems relevant to the society.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3									3		
CO3	3									3		
CO4	3	2				3						

Comprehensive Course Viva:
The comprehensive course viva in the eighth semester of study shall have an oral examination based on the core subjects studied from third to eighth semester. The viva voce will be conducted by the same three member committee assigned for final Project Phase II evaluation **(Project coordinator, expert from industry/ academic or research institute and a senior faculty from a sister department)** towards the end of the semester. The course should be mapped with a faculty and classes shall be arranged for practicing questions based on the core courses listed in the curriculum. The mark will be treated as internal and should be uploaded along with internal marks of other courses. Syllabus for the comprehensive course viva is based on core courses in the branch.

BTD416	PROJECT PHASE II	CATEGORY	L	T	P	CREDIT
		PWS	0	0	12	4

Preamble:

The course 'Project Work' is mainly intended to evoke the innovation and invention skills in a student. The course will provide an opportunity to synthesize and apply the knowledge and analytical skills learned, to be developed as a prototype or simulation. The project extends to 2 semesters and will be evaluated in the 7th and 8th semester separately, based on the achieved objectives. One third of the project credits shall be completed in 7th semester and two third in 8th semester. It is recommended that the projects may be finalized in the thrust areas of the respective engineering stream or as interdisciplinary projects. Importance should be given to address societal problems and developing indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem solving.
- To foster innovation in design of products, processes or systems.
- To develop creative thinking in finding viable solutions to engineering problems.

Course Outcomes [COs]: After successful completion of the course, the students will be able to:

CO1	Model and solve real world problems by applying knowledge across domains (Cognitive knowledge level: **Apply**).
CO2	Develop products, processes or technologies for sustainable and socially relevant applications (Cognitive knowledge level: **Apply**).
CO3	Function effectively as an individual and as a leader in diverse teams and to comprehend and execute designated tasks (Cognitive knowledge level: **Apply**).
CO4	Plan and execute tasks utilizing available resources within timelines, following ethical and professional norms (Cognitive knowledge level: **Apply**).
CO5	Identify technology/research gaps and propose innovative/creative solutions (Cognitive knowledge level: **Analyze**).
CO6	Organize and communicate technical and scientific findings effectively in written and oral forms (Cognitive knowledge level: **Apply**).

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1	2	2	2	1	1	1	1	2
CO2	2	2	2		1	3	3	1	1		1	1
CO3									3	2	2	1
CO4					2			3	2	2	3	2
CO5	2	3	3	1	2							1
CO6					2			2	2	3	1	1

Abstract POs defined by National Board of Accreditation			
PO #	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	PO7	Environment and Sustainability
PO2	Problem Analysis	PO8	Ethics
PO3	Design/Development of solutions	PO9	Individual and team work
PO4	Conduct investigations of complex problems	PO0	Communication
PO5	Modern tool usage	PO11	Project Management and Finance
PO6	The Engineer and Society	PO12	Lifelong learning

PROJECT PHASE II

Phase 2 Targets

- In depth study of the topic assigned in the light of the report prepared under Phase - I;
- Review and finalization of the approach to the problem relating to the assigned topic.
- Preparing a detailed action plan for conducting the investigation, including teamwork.
- Detailed Analysis/ Modeling / Simulation/ Design/ Problem Solving/Experiment as needed.
- Final development of product/ process, testing, results, conclusions and future directions.
- Preparing a paper for Conference Presentation/ Publication in Journals, if possible.
- Presenting projects in Project Expos conducted by the University at the cluster level and/ or state level as well as others conducted in India and abroad.
- Filing Intellectual Property Rights (IPR) if applicable.
- Preparing a report in the standard format for being evaluated by the Department Assessment Board.
- Final project presentation and viva voce by the assessment board including the external expert.

Evaluation Guidelines & Rubrics

Total: 150 marks (Minimum required to pass: 75 marks).

- Project progress evaluation by guide: 30 Marks.
- Two interim evaluations by the Evaluation Committee: 50 Marks (25 marks for each evaluation).
- Final evaluation by the Final Evaluation committee: 40 Marks
- Quality of the report evaluated by the evaluation committee: 30 Marks

(The evaluation committee comprises HoD or a senior faculty member, Project coordinator and project supervisor. The final evaluation committee comprises of Project coordinator, expert from Industry/research/academic Institute and a senior faculty from a sister department).

Evaluation by the Guide

The guide/supervisor must monitor the progress being carried out by the project groups on regular basis. In case it is found that progress is unsatisfactory it should be reported to the Department Evaluation Committee for necessary action. The presence of each student in the group and their involvement in all stages of execution of the project shall be ensured by the guide. Project evaluation by the guide: 30 Marks. This mark shall be awarded to the students in his/her group by considering the following aspects:

Project Scheduling & Distribution of Work among Team members: Detailed and extensive Scheduling with timelines provided for each phase of project. Work breakdown structure well defined. (5)

Literature survey: Outstanding investigation in all aspects. (4)

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily/weekly activity diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily/weekly activity diary shall be signed after every day/week by the guide. (7)

Individual Contribution: The contribution of each student at various stages. (9)

Completion of the project: The students should demonstrate the project to their respective guide. The guide shall verify the results and see that the objectives are met. (5)

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation - 1						
No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-a	Novelty of idea, and Implementation scope [CO5] [Group Evaluation]	**5**	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea can be implemented. There is still lack of originality in the work done so far by the team. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team . There is fresh specifications/ features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable / publishable work.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-b	Effectiveness of task distribution among team members. [CO3] [Group Evaluation]	**5**	No task distribution of any kind. Members are still having no clue on what to do.	Task allocation done, but not effectively, some members do not have any idea of the tasks assigned. Some of the tasks were identified but not followed individually well.	Good evidence of task allocation being done, supported by project journal entries, identification of tasks through discussion etc. However, the task distribution seems to be skewed, and depends a few members heavily than others. Mostly the tasks are being followed by the individual members.	Excellent display of task identification and distribution backed by documentary evidence of team brainstorming, and project journal entries. All members are allocated tasks according to their capabilities, and as much as possible in an equal manner. The individual members are following the tasks in an excellent manner.
			(0 – 1 Marks)	(2 – 3 Marks)	(4 Marks)	(5 Marks)
2-c	Adherence to project schedule. [CO4] [Group Evaluation]	**5**	Little or no evidence of continued planning or scheduling of the project. The students did not stick to the plan what they were going to build nor plan on what materials / resources to use in the project. The students do not have any idea on the budget required even after the end of phase - I. No project journal kept or the journal.	There is some improvement in the primary plan prepared during phase I. There were some ideas on the materials /resources required, but not really thought out. The students have some idea on the finances required, but they have not formalized a budget plan. Schedules were not prepared. The project journal has no useful details on the project.	Good evidence of planning done and being followed up to a good extent after phase I. Materials were listed and thought out, but the plan wasn't followed completely. Schedules were prepared, but not detailed, and needs improvement. Project journal is presented but it is neither complete nor updated regularly.	Excellent evidence of enterprising and extensive project planning and follow-up since phase I. Continued use of project management/version control tool to track the project. Material procurement if applicable is progressing well. Tasks are updated and incorporated in the schedule. A well-kept project journal showed evidence for all the above, in addition to the interaction with the project guide.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)

2-d	Interim Results. [CO6] [Group assessment]	**5**	There are no interim results to show.	The team showed some interim results, but they are not complete / consistent to the current stage, Some corrections are needed.	The interim results showed were good and mostly consistent/correct with respect to the current stage. There is room for improvement.	There were significant interim results presented which clearly shows the progress.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-e	Presentation [Individual assessment]	**5**	Very poor presentation and there is no interim results. The student has no idea about the project proposal.	Presentation is average, and the student has only a feeble idea about the team work.	Good presentation. Student has good idea about the team's project. The overall presentation quality is good.	Exceptionally good presentation. Student has excellent grasp of the project. The quality of presentation is outstanding.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 1 Total Marks: 25						

EVALUATION RUBRICS for PROJECT Phase II: Interim Evaluation – 2						
No	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-f	Application of engineering knowledge [CO1] [Individual Assessment]	**10**	The student does not show any evidence of applying engineering knowledge on the design and the methodology adopted. The student's contribution in application of engineering knowledge in the project is poor.	The student appears to apply some basic knowledge, but not able to show the design procedure and the methodologies adopted in a comprehensive manner.	The student is able to show some evidence of application of engineering knowledge in the design and development of the project to good extent.	Excellent knowledge in design procedure and its adaptation. The student is able to apply knowledge from engineering domains to the problem and develop solutions.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-g	Involvement of individual members [CO3] [Individual Assessment]	**5**	No evidence of any Individual participation in the project work.	There is evidence for some amount of individual contribution, but is limited to some of the superficial tasks.	The individual contribution is evident. The student has good amount of involvement in core activities of the project.	Evidence available for the student acting as the core technical lead and has excellent contribution to the project.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-h	Results and inferences upon execution [CO5] [Group Assessment]	**5**	None of the expected outcomes are achieved yet. The team is unable to derive any inferences on the failures/ issues observed. Any kind o f observations or studies are not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Documentation and presentation. .[CO6] [Individual assessment]	**5**	The individual student has no idea on the presentation of his/her part. The presentation is of poor quality.	Presentation's overall quality needs to be improved.	The individual's presentation performance is satisfactory.	The individual's presentation is done professionally and with great clarity. The individual's performance is excellent.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
Phase-II Interim Evaluation - 2 Total Marks: 25						

EVALUATION RUBRICS for PROJECT Phase II: Final Evaluation

No	Parameters	Marks	Poor	Fair	Very Good	Outstanding
2-j	Engineering knowledge. [CO1] [Group Assessment]	10	The team does not show any evidence of applying engineering knowledge on the design and the methodology adopted.	The team is able to show some of the design procedure and the methodologies adopted, but not in a comprehensive manner.	The team is able to show evidence of application of engineering knowledge in the design and development of the project to good extent. There is scope for improvement.	Excellent knowledge in design procedure and its adaptation. The team is able to apply knowledge from engineering domains to the problem and develop an excellent solution.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)
2-k	Relevance of the project with respect to societal and/or industrial needs. [Group Assessment] [CO2]	5	The project as a whole do not have any societal / industrial relevance at all.	The project has some relevance with respect to social and/or industrial application. The team has however made not much effort to explore further and make it better.	The project is relevant to the society and/or industry. The team is mostly successful in translating the problem into an engineering specification and managed to solve much of it.	The project is exceptionally relevant to society and/or industry. The team has made outstanding contribution while solving the problem in a professional and/ or ethical manner.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-i	Innovation / novelty / Creativity [CO5] [Group Assessment]	5	The project is not addressing any useful requirement. The idea is evolved into a non-implementable one. The work presented so far is lacking any amount of original work by the team.	Some of the aspects of the proposed idea appears to be practical. There is still lack of originality in the work done. The project is a regularly done theme/topic without any freshness in terms of specifications, features, and/ or improvements.	Good evidence of an implementable project. There is some evidence for the originality of the work done by the team. There is fresh specifications/ features/improvements suggested by the team. The team is doing a design from fundamental principles, and there is some independent learning and engineering ingenuity. Could be translated into a product / process if more work is done.	The project has evolved into incorporating an outstandingly novel idea. Original work which is not yet reported anywhere else. Evidence for ingenious way of innovation which is also Implementable. Could be a patentable publishable work.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
2-m	Quality of results / conclusions / solutions. [CO1] [Group Assessment]	10	None of the expected outcomes are achieved. The team is unable to derive any inferences on the failures/issues observed. Any kind of observations or studies is not made.	Only a few of the expected outcomes are achieved. A few inferences are made on the observed failures/issues. No further work suggested.	Many of the expected outcomes are achieved. Many observations and inferences are made, and attempts to identify the issues are done. Some suggestions are made for further work.	Most of the stated outcomes are met. Extensive studies are done and inferences drawn. Most of the failures are addressed and solutions suggested. Clear and valid suggestions made for further work.
			(0 – 3 Marks)	(4 – 6 Marks)	(7 - 9 Marks)	(10 Marks)

2-n	Presentation - Part I Preparation of slides. [CO6] [Group Assessment].	5	The presentation slides are shallow and in a clumsy format. It does not follow proper organization.	Presentation slides follow professional style formats to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly, or acknowledged. Presentation slides needs to be more professional.	Presentation slides follow a good style format and there are only a few issues. Organization of the slides is good. Most of references are cited properly. The flow is good and team presentation is neatly organized. Some of the results are not clearly shown. There is room for improvement.	The presentation slides are exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and l i s ted. Results/ inferences clearly highlighted and readable.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
	Presentation - Part II: Individual Communication [CO6] [Individual Assessment].	5	The student is not communicating properly. Poor response to questions.	The student is able to explain some of the content. The student requires a lot of prompts to get to the idea. There are language issues.	Good presentation/ communication by the student. The student is able to explain most of the content very well. There are however, a few areas where the student shows lack of preparation. Language is better.	Clear and concise communication exhibited by the student. The presentation is outstanding. Very confident and tackles all the questions without hesitation. Exceptional traits of communicator.
			(0 - 1 Marks)	(2 - 3 Marks)	(4 Marks)	(5 Marks)
			Phase-II Final Evaluation,	**Marks: 40**		

EVALUATION RUBRICS for PROJECT Phase II: Report Evaluation						
Sl. No.	**Parameters**	**Marks**	**Poor**	**Fair**	**Very Good**	**Outstanding**
2-o	Report [CO6]	30	The prepared report is shallow and not as per standard format. It does not follow proper organization. Contains mostly unacknowledged content. Lack of effort in preparation is evident. References are not cited. Unprofessional and inconsistent formatting.	Project report follows the standard format to some extent. However, its organization is not very good. Language needs to be improved. All references are not cited properly in the report. There is lack of formatting consistency.	Project report shows evidence of systematic documentation. Report is mostly following the standard style format and there are only a few issues. Organization of the report is good. Mostly consistently formatted. Most of references/sources are cited/ acknowledged properly.	The report is exceptionally good. Neatly organized. All references cited properly. Diagrams/Figures, Tables and equations are properly numbered, and listed and clearly shown. Language is excellent and follows professional styles. Consistent formatting and exceptional readability.
			(0 - 11 Marks)	(12 - 18 Marks)	(19 - 28 Marks)	(29 - 30 Marks)
Phase - II Project Report Marks: 30						

BTD482	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble:

Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Biotechnology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

The Continuous Internal Evaluation (CIE) is conducted by evaluating the progress of the mini project through minimum of TWO reviews. At the time of the 1^{st} review, students are supposed to propose a new system/design/idea, after completing a thorough literature study of the existing systms under their chosen area. In the 2^{nd} review students are expected to highlight the implementation details of the proposed solution. The review committee should assess the extent to which the implementation reflects the proposed design. A well coded, assembled and completely functional product is the expected output at this stage. The final CIE mark is the average of 1^{st} and 2^{nd} review marks.

A zeroth review may be conducted before the beginning of the project to give a chance for the students to present their area of interest or problem domain or conduct open brain storming sessions for innovative ideas. Zeroth review will not be a part of the CIE evaluation process.

Marks Distribution

Total Marks	CIE	ESE
150	75	75

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Marks awarded by Guide : 15 marks
Project Report : 10 marks
Evaluation by the Committee : 40 Marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.
(a) Demonstration : 50 Marks
(b) Project report : 10 Marks
(d) Viva voce : 15marks

Course Plan

In this course, each group consisting of three/four members is expected to design and develop a moderately complex software/hardware system with practical applications. This should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty-in-charge of miniproject/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

BTD496	MINI PROJECT	CATEGORY	L	T	P	CREDIT
		PWS	0	0	3	4

Preamble: Mini Project Phase I: A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The object of Project Work I is to enable the student to take up investigative study in the broad field of Biotechnology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on a group of three/four students, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

- Survey and study of published literature on the assigned topic;
- Preparing an Action Plan for conducting the investigation, including team work;
- Working out a preliminary Approach to the Problem relating to the assigned topic;
- Block level design documentation
- Conducting preliminary Analysis/ Modelling/ Simulation/ Experiment/ Design/ Feasibility;
- Preparing a Written Report on the Study conducted for presentation to the Department;

CO1	Identify and synthesize problems and propose solutions to them.
CO2	Prepare work plan and liaison with the team in completing as per schedule.
CO3	Validate the above solutions by theoretical calculations and through experimental
CO4	Write technical reports and develop proper communication skills.
CO5	Present the data and defend ideas.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3					3	3		2
CO2	3			3				3	3	3	3	
CO3	3	3	3	3	3					3		
CO4					3			3	3	3		1
CO5	3	3	3	3				3		3	3	1

*1-slight/low mapping, 2- moderate/medium mapping, 3-substantial/high mapping

Assessment Pattern

The End Semester Evaluation (ESE) will be conducted as an internal evaluation based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, academic coordinator for that program and project guide/coordinator. The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, working knowledge and involvement.

The Continuous Internal Evaluation (CIE) is conducted by evaluating the progress of the mini project through minimum of TWO reviews. At the time of the 1st review, students are supposed to propose a new system/design/idea, after completing a thorough literature study of the existing systms under their chosen area. In the 2nd review students are expected to highlight the implementation details of the proposed solution. The review committee should assess the extent to which the implementation reflects the proposed design. A well coded, assembled and completely functional product is the expected output at this stage. The final CIE mark is the average of 1st and 2nd review marks.

A zeroth review may be conducted before the beginning of the project to give a chance for the students to present their area of interest or problem domain or conduct open brain storming sessions for innovative ideas. Zeroth review will not be a part of the CIE evaluation process.

Marks Distribution

Total Marks	CIE	ESE
150	75	75

Continuous Internal Evaluation Pattern:
Attendance : 10 marks
Marks awarded by Guide : 15 marks
Project Report : 10 marks
Evaluation by the Committee : 40 Marks

End Semester Examination Pattern: The following guidelines should be followed regarding award of marks.
(a) Demonstration : 50 Marks
(b) Project report : 10 Marks
(d) Viva voce : 15marks

Course Plan

In this course, each group consisting of three/four members is expected to design and develop a moderately complex software/hardware system with practical applications. This should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty-in-charge of miniproject/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.