1. Bio-Informatics : Algorithms and Applications

Course layout

**Week 1** :  Introduction, DNA sequence analysis, DNA Databases
**Week 2**:   Protein structure and function, protein sequence databases, sequence alignment
**Week 3** :  PAM matrix, Global and local alignment, BLAST: features and scores
**Week 4** :  Multiple sequence alignment, Conservation score, phylogenetic trees
**Week 5**  :  Protein sequence analysis, hydrophobicity profiles, non-redundant datasets
**Week 6** :  Protein secondary structures, Ramachandran plot, propensity, secondary structure prediction
**Week 7** :  Protein tertiary structure, Protein Data Bank, visualization tools, structural classification, contact maps
**Week 8** :  Protein structural analysis, protein structure prediction
**Week 9** :  Protein stability, energetic contributions, database, stabilizing residues, stability upon mutations
**Week 10 :**  Protein folding rates, proteins interactions, binding site residues
**Week 11** : Computer aided drug design, docking, screening, QSAR
**Week 12** :  Development of algorithms, awk programming, machine learning techniques, applications using WEKA

1. Applied Environmental Microbiology

Course layout

**Week 1 :** Introduction; cell elements and composition Cell and its composition, cytoplasmic membrane Prokaryotic cell division Microbes and their environmental niches Historical roots of microbiology Nucleic acids and amino acids DNA structure, replication, and manipulation Protein and its structure Regulation Microbial nutrition Microscopy: Light microscopy, 3D Imaging, AFM, Confocal scanning laser microscopy

**Week 2**: Microbial energetics  and diversity Stoichiometry and bioenergetics Oxidation-reduction NAD, energy-rich compounds and energy storage Mathematics of microbial growth Glycolysis Respiration Citric-acid cycle Catabolic Alternatives Phototrophy, Chemolithotrophy, anaerobic respiration (Nitrate and Sulfate reduction; Acetogenesis; Methanogenesis; Metal, Chlorate, and organic electron acceptors)

**Week 3 :** Microbial metabolism and functional diversity of bacteria Prokaryotic diversity Classical taxonomy  Origin of life Tree of life Major catabolic pathways Catalysis and enzymes Energy conservation Sugars and polysaccharides, amino acids, nucleotides, lipids

**Week 4 :** Microbial ecosystems Population, guilds, and communities Environments and microenvironments Microbial growth on surfaces Environmental effects on microbial growth

**Week 5 :** Environmental genomics and microbial ecology; genetic exchange Environmental genomics Microbial ecology  Horizontal and vertical gene transfer: Replication, Transformation Transduction

**Week 6 :** Microbial symbiosis and virus, Mutation and its rate ,Genetic recombination, Population dynamics ,Virus ,Viroid, Prion ,Application of environmental microbes

**Week 7 :**Investigations in environmental microbiology: sampling, detection, isolation, taxonomic and functional annotation and quantification; Introductory bioinformatics and data analysis Microbial sampling Culture based and culture independent tools Molecular biology tools: Cloning, amplification, sequencing,Case study

**Week 8 :** Bioremediation and wastewater microbiology, Bioremediation and examples, Acid mine drainage, Enhanced metal recovery, Wastewater microbiology

**Week 9 :**Drinking water microbiology, Drinking water microbiome and treatment, Microbial instability ,Water borne microbial diseases

**Week 10 :** Solid waste microbiology and antimicrobial resistance, Landfills,  Leachate, Anaerobic degradation phases, Antimicrobial resistance

**Week  11:** Epidemiology and biosensors ,Public health, Epidemics, Biosensors ,Wearable biosensors

**Week 12 :** Built microbiology, exposomes and bioinformatics, Exposure routes ,Microbes living around us ,Exposomes Basic bioinformatics, Bioinformatics tools available online

1. Product Design and Development

Course layout

**Week1:**Introduction to course, Product life-cycle, Product policy of an organization. Selection of a profitable product, Product design process,Product analysis.

**Week 2:**Value engineering in product design; Advantages, Applications in product design, Problem identification and selection, Analysis of functions, Anatomy of function.Primary versus secondary versus tertiary/unnecessary functions, Functional analysis: Functional Analysis System Technique (FAST), Case studies.

**Week 3:**Introduction to product design tools, QFD, Computer Aided Design, Robust design, DFX, DFM, DFA,Ergonomics in product design,.

**Week 4:**DFMA guidelines, Product design for manual assembly, Design guidelines for metallic and non-metallic products to be manufactured by different processes such as casting, machining, injection molding etc., Rapid prototyping, needs, advantages, working principle of SLA, LOM and SLS

1. Functional Genomics

Course layout

**Week 1:** [2.5 hrs; 4 lectures]
*Introduction to Functional Genomics:*
Pre- and post-genomic era; major advancements in genomic approaches;  epigenetics and metagenomics; forward versus reverse genetics

**Week 2**: [2.5 hrs; 4 lectures]
*Genome Analyses - Part 1*
Genome editing approaches and their applications; gene expression analyses and applications

**Week 3:**[3 hrs: 4 lectures and 2 tutorial sessions]
*Genome Analyses - Part 2*
Methods for DNA/RNA sequencing, sequence analysis and their applications

**Week 4:** [2.5 hrs: 3 lectures and 2 laboratory sessions]
*Comparative Genomics*
Genomic insight into evolution; power of comparative genomic analysis

1. Python for Data Science

Course layout

**Week 1:**
•**BASICS OF PYTHON SPYDER (TOOL)**

• Introduction Spyder

• Setting working Directory

• Creating and saving a script file

• File execution, clearing console, removing variables from environment, clearing environment

• Commenting script files

• Variable creation

• Arithmetic and logical operators

• Data types and associated operations

 **Week 2:**

**Sequence data types and associated operations**

•        Strings
•        Lists
•        Arrays
•        Tuples
•        Dictionary
•        Sets
•        Range

**NumPy**
•        ndArray

**Week 3:**
•**Pandas dataframe and dataframe related operations on Toyota Corolla dataset**

1. Reading files
2. Exploratory data analysis
3. Data preparation and preprocessing

•**Data visualization on Toyoto Corolla dataset using matplotlib and seaborn libraries**

1. Scatter plot
2. Line plot
3. Bar plot
4. Histogram
5. Box plot
6. Pair plot

•**Control structures using Toyota Corolla dataset**

1. if-else family
2. for loop
3. for loop with if break
4. while loop

•**Functions**
 **Week 4: CASE STUDY**

•**Regression**

1. Predicting price of pre-owned cars

•**Classification**

1. Classifying personal income