**1)Bioengineering: An Interface with Biology and Medicine**

Course layout

**Week 1** :  Why biology for engineers: Part-I, Why biology for engineers: Part-II, Life processes &
 Cell, Cell and its properties, Clinician’s Perspective-I
**Week 2**:  DNA Tools-Gene cloning, DNA Tools-Gene cloning-II, DNA Tools & Biotechnology, DNA Tools &
  Biotechnology-II,
**Week 3** :  DNA Tools & Biotechnology-III, DNA Tools & Biotechnology-IV, DNA Tools & Biotechnology-V, DNA
  Tools & Biotechnology-VI, Clinician’s Perspective-III
**Week 4** :  Genetics-I, Genetics-II, Genetics-III, Genetics-IV, Clinician’s Perspective-IV
**Week 5** :  Chromosomal basis of inheritance, Linkage, chromosomal disorders, Classical Genetics experiments,
  Bacteria and Viruses, Clinician’s Perspective-V
**Week 6** :  Cell cycle, Cell cycle disregulation & Cancer, Developmental Biology, Principles and application of Animal
  Cloning, Evolution & Bioinformatics
**Week 7** :  Amino acids & proteins, Proteins & Proteomics, Techniques to Study Protein & Proteome-I, Techniques to
  Study Protein & Proteome-II, Techniques to Study Protein & Proteome-III **Week 8** :  Techniques to Study Protein & Proteome-IV, Protein Interactions & Microarrays, Protein interactions & Systems
   biology, Bioinformatics, Ethics in Research and Publications

Books and references

Campbell Biology

### 2) Biomedical nanotechnologyCourse layout

**Week 1:**   Introduction to nano, Nano-biomimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterisation of nanomaterials.
**Week 2:**   DNA nanotechnology, Protein & glyco nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications.
**Week 3:**   Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing.
**Week 4:**   Nanotechnology in point-of-care diagnostics, Nanopharmacology & drug targeting, Cellular uptake mechanisms of nanomaterials, In vitro methods to study antibacterial and anticancer properties of nanomaterials, Nanotoxicology.

Books and references

1. Malsch, N.H., “Biomedical Nanotechnology”, CRC Press. (2005).
2. Mirkin, C.A. and Niemeyer, C.M., “Nanobiotechnology II: More Concepts and Applications”, Wiley-VCH. (2007).
3. Kumar, C. S. S. R., Hormes, J. and Leuschner C., “Nanofabrication Towards Biomedical Applications: Techniques, Tools, Applications, and Impact”, WILEY -VCH Verlag GmbH & Co. (2005).
4. Lamprecht, A., “Nanotherapeutics: Drug Delivery Concepts in Nanoscience”, Pan Stanford Publishing Pte. Ltd. (2009).
5. Jain, K.K., “The Handbook of Nanomedicine”, Humana press. (2008).

**3)** **Nanotechnology in Agriculture**

Course layout

**Week 1:**History of agriculture and the  role of chemicals in modern agriculture

**Week 2:**Overview of nanotechnology

**Week 3:**Application of nanotechnology in modern day agriculture practices I

**Week 4:**Application of nanotechnology in modern day agriculture practices II

**Week 5:**Application of nanotechnologies in animal production

**Week 6:**Nanotechnology and shelf life of agricultural and food products

**Week 7:**Nanotechnologies for water quality and availability

**Week 8:**Green nanotechnology and the role of good governance and policies for effective nanotechnology development

Books and references

•   E-Reference materials will be provided during the course

**4) 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

Books and references

Mostly publically available literature. Will be shared with the participants during the launch of the course.

**5) Computer Aided Drug Design**

Course layout

**Week 1** :  Introduction to drug discovery
**Week 2**:  Structure and property
**Week 3** :  ADME-rules
**Week 4** :  Force field/MM/QM
**Week 5** :  Boundary conditions/Conformation
**Week 6** :  QSAR/Pharmacophore
**Week 7** :  Enzymes/proteins structures/docking
**Week 8** :  PK/PD

Books and references

1. Voit E (2012) A First Course in Systems Biology. Garland Science, 1/e. ISBN 0815344678 • Klipp E (2009) Systems biology: a textbook. Wiley-VCH, 1/e. ISBN 9783527318742 • Newman MEJ (2011) Networks: an introduction. Oxford Univ. Press. ISBN 9780199206650

### 6) Course layout

**Week 1** :  Basics of Proteins and Proteomics

Lecture 1 : Introduction to amino acids
Lecture 2 : Introduction to Proteins
Lecture 3 : Protein folding & misfolding
Lecture 4 : Introduction to Proteomics
Lecture 5 : Lab session – Protein-protein interaction using label-free biosensors

**Week 2**:   Gel-based proteomics

Lecture 6:   Sample preparation and pre-analytical factors
Lecture 7 :  Sample preparation: Pre-analytical factors (contd.)
Lecture 8 :  Sample preparation: Protein extraction and quantification
Lecture 9 :  One-dimensional electrophoresis
Lecture 10 : Introduction to 2-DE

**Week 3** : Two-dimensional gel electrophoresis (2-DE)

Lecture 11 : 2-DE: Second dimension, staining & destaining
Lecture 12 : 2-DE: Gel analysis
Lecture 13 : 2-DE Applications
Lecture 14 : 2-DE Applications (contd.) & Challenges
Lecture 15 : Lab session - Protein/peptide pre-fractionation using OFFGEL FRACTIONATOR & data analysis

**Week 4** :  Difference in gel electrophoresis (DIGE) & Systems Biology

Lecture 16 : 2D-DIGE: Basics
Lecture 17 : 2D-DIGE: Data analysis
Lecture 18 : 2D-DIGE: Applications
Lecture 19 : Systems biology and proteomics – I
Lecture 20 : Systems biology and proteomics - II

**Week 5** :  Basics of mass spectrometry

Lecture 21 : Fundamentals of mass spectrometry
Lecture 22 : Chromatography technologies
Lecture 23 : Liquid chromatography
Lecture 24 : Mass spectrometry: Ionization sources
Lecture 25 : Mass spectrometry: Mass analyzers

**Week 6** :  Basics of mass spectrometry and sample preparation

Lecture 26 :  MALDI sample preparation and analysis
Lecture 27 :  Hybrid mass spectrometry configurations
Lecture 28 :  Lab session - Demonstration of Q-TOF MS technology
Lecture 29 :  In-gel & in-solution digestion
Lecture 30 :  Lab session - Sample preparation: tissue sample preservation technology

**Week 7** :  Quantitative proteomics

Lecture 31 :  Introduction to quantitative proteomics
Lecture 32 :  SILAC: In vivo labelling
Lecture 33 :  iTRAQ: In vitro labelling
Lecture 34 :  TMT: In vitro labelling
Lecture 35 :  Quantitative proteomics data analysis

**Week 8     :**

Advancement in Proteomics

Lecture 36  : Proteomics applications
Lecture 37 :  Challenges in proteomics
Lecture 38 :  OMICS and translational research
Lecture 39 :  Lab session – Targeted proteomics using triple quadrupole mass spectrometry
Lecture 40 :  Lab session – Targeted proteomics: multiple reaction monitoring

Books and references

Nil

# **7) Introduction To Programming In C**

Course layout

**Week 1** : Introduction. Straight-Line Code. Variables, Operators, Expressions and Conditionals.

**Week 2** : Loops

**Week 3** : Functions

**Week 4** : One-Dimensional Arrays and Pointers

**Week 5** : Recursion

**Week 6** : Multi-dimensional Arrays, Linked Lists.

**Week 7** : Operating on Files

**Week 8** : Organizing C projects, working with multiple source directories, makefiles

# **8) Programming, Data Structures And Algorithms Using Python**

Course layout

**Week 1**
Informal introduction to programmin, algorithms and data structures viagcd
Downloading and installing Python
gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions

**Week 2**
Python: types, expressions, strings, lists, tuples
Python memory model: names, mutable and immutable values
List operations: slices etc
Binary search
Inductive function denitions: numerical and structural induction
Elementary inductive sorting: selection and insertion sort
In-place sorting

**Week 3**
Basic algorithmic analysis: input size, asymptotic complexity, O() notation
Arrays vs lists
Merge sort
Quicksort
Stable sorting

**Week 4**
Dictionaries
More on Python functions: optional arguments, default values
Passing functions as arguments
Higher order functions on lists: map, lter, list comprehension

**Week 5**
Exception handling
Basic input/output
Handling files
String processing

**Week 6**
Backtracking: N Queens, recording all solutions
Scope in Python: local, global, nonlocal names
Nested functions
Data structures: stack, queue
Heaps

**Week 7**
Abstract datatypes
Classes and objects in Python
"Linked" lists: find, insert, delete
Binary search trees: find, insert, delete
Height-balanced binary search trees

**Week 8**
Effcient evaluation of recursive definitions: memoization
Dynamic programming: examples
Other programming languages: C and manual memory management
Other programming paradigms: functional programming

# 9) **Cloud Computing and Distributed Systems**

Course layout

**Week 1: Introduction to Clouds, Virtualization and Virtual Machine**

1. Introduction to Cloud Computing: Why Clouds, What is a Cloud,Whats new in todays Clouds, Cloud computing vs. Distributed computing, Utility computing, Features of today’s Clouds: Massive scale,  AAS Classification: HaaS, IaaS, PaaS, SaaS, Data-intensive Computing, New Cloud Paradigms, Categories of Clouds: Private clouds, Public clouds

2. Virtualization: What’s virtualization, Benefits of Virtualization, Virtualization Models: Bare metal, Hosted hypervisor

3. Types of Virtualization: Processor virtualization, Memory virtualization, Full virtualization, Para virtualization, Device virtualization

4. Hotspot Mitigation for Virtual Machine Migration: Enterprise Data Centers, Data Center Workloads, Provisioning methods, Sandipiper Architecture, Resource provisioning, Black-box approach, Gray-box approach, Live VM Migration Stages, Hotspot Mitigation

**Week 2**: **Network Virtualization and Geo-distributed Clouds**

1. Server Virtualization: Methods of virtualization: Using Docker,Using Linux containers, Approaches for Networking of VMs: Hardware approach: Single-root I/O virtualization (SR-IOV), Software approach: Open vSwitch, Mininet and its applications

2. Software Defined Network: Key ideas of SDN, Evolution of SDN,SDN challenges, Multi-tenant Data Centers: The challenges, Network virtualization, Case Study: VL2, NVP

3. Geo-distributed Cloud Data Centers: Inter-Data Center Networking, Data center interconnection techniques: MPLS, Google’s B4 and  Microsoft’s Swan

**Week 3**: **Leader Election in Cloud, Distributed Systems and Industry Systems**

1. Leader Election in Rings (Classical Distributed Algorithms): LeLann-Chang-Roberts (LCR) algorithm, The Hirschberg and Sinclair (HS) algorithm

2. Leader Election (Ring LE & Bully LE Algorithm): Leader Election Problem, Ring based leader election, Bully based leader election, Leader Election in Industry Systems: Google’s Chubby and  Apache Zookeeper

3. Design of Zookeeper: Race condition, Deadlock, Coordination, Zookeeper design goals, Data model, Zookeeper architecture, Sessions, States, Usecases, Operations, Access Control List (ACL), Zookeeper applications: Katta, Yahoo! Message Broker

**Week 4**: **Classical Distributed Algorithms and the Industry Systems**

1. Time and Clock Synchronization in Cloud Data Centers: Synchronization in the cloud, Key challenges, Clock Skew, Clock Drift, External and Internal clock synchronization, Christians algorithm, Error bounds, Network time protocol (NTP), Berkley’s algorithm, Datacenter time protocol (DTP), Logical (or Lamport) ordering, Lamport timestamps, Vector timestamps

2. Global State and Snapshot Recording Algorithms: Global state, Issues in Recording a Global State, Model of Communication, Snapshot algorithm: Chandy-Lamport Algorithm

3. Distributed Mutual Exclusion: Mutual Exclusion in Cloud, Central algorithm, Ring-based Mutual Exclusion, Lamport’s algorithm, Ricart-Agrawala’s algorithm, Quorum-based Mutual Exclusion, Maekawa’s algorithm, Problem of Deadlocks, Handling Deadlocks, Industry Mutual Exclusion : Chubby

**Week 5**: **Consensus, Paxos and Recovery in Clouds**

1. Consensus in Cloud Computing and Paxos: Issues in consensus, Consensus in synchronous and asynchronous system, Paxos Algorithm

2. Byzantine Agreement: Agreement, Faults, Tolerance, Measuring Reliability and Performance, SLIs, SLOs, SLAs, TLAs, Byzantine failure, Byzantine Generals Problem, Lamport-Shostak-Pease Algorithm, Fischer-Lynch-Paterson (FLP) Impossibility

3. Failures & Recovery Approaches in Distributed Systems: Local checkpoint, Consistent states, Interaction with outside world, Messages, Domino effect, Problem of Livelock,  Rollback recovery schemes, Checkpointing and Recovery Algorithms: Koo-Toueg Coordinated Checkpointing Algorithm

**Week 6**: **Cloud Storage: Key-value stores/NoSQL**

1. Design of Key-Value Stores: Key-value Abstraction, Key-value/NoSQL Data Model, Design of Apache Cassandra, Data Placement Strategies, Snitches, Writes, Bloom Filter, Compaction, Deletes, Read, Membership, CAP Theorem, Eventual Consistency, Consistency levels in Cassandra, Consistency Solutions

2. Design of HBase: What is HBase, HBase Architecture, Components, Data model, Storage Hierarchy, Cross-Datacenter Replication, Auto Sharding and Distribution, Bloom Filter, Fold, Store, and Shift

**Week 7**: **P2P Systems and their use in Industry Systems**

1. Peer to Peer Systems in Cloud Computing: Napster, Gnutella, FastTrack, BitTorrent, DHT, Chord, Pastry and Kelips.

**Week 8**: **Cloud Applications: MapReduce, Spark and Apache Kafka**

1. MapReduce: Paradigm, Programming Model, Applications, Scheduling, Fault-Tolerance, Implementation Overview, Examples

2. Introduction to Spark: Resilient Distributed Datasets (RDDs), RDD Operations, Spark applications: Page Rank Algorithm, GraphX, GraphX API, GraphX working

3.Introduction to Kafka: What is Kafka, Use cases for Kafka, Data model, Architecture, Types of messaging systems, Importance of brokers

Books and references

**Text Books:**

1. Distributed and Cloud Computing From Parallel Processing to the Internet of Things- Kai Hwang, Jack Dongarra, Geoffrey Fox

2. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011

3. Distributed Computing: Principles, Algorithms, and Systems- Ajay D. Kshemkalyani and Mukesh Singhal

4. Distributed Computing: Fundamentals, Simulations and Advanced Topics-Hagit Attiya and Jennifer Welch

**Reference Book:**

1.Distributed Algorithms-Nancy Lynch

2.Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

3.Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012

# **10) Blockchain Architecture Design and Use Cases**

Course layout

**Week 1**

Introduction to Blockchain – I (Basics, History, Architecture, Conceptualization)

Basic Crypto Primitives

**Week 2**

Basic Crypto Primitives Continued..

Bitcoin Basics

Distributed Consensus

**Week 3**

Consensus in Bitcoin – I (The Basics, PoW and Beyond, The Miners)

Permissioned Blockchain (Basics, Consensus)

**Week 4**

Permissioned Blockchain(RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance)

Blockchain for Enterprise - Overview

Blockchain Components and Concepts

**Week 5**

Hyperledger Fabric – Transaction Flow

Hyperledger Fabric Details

Fabric – Membership and Identity Management

Hyperledger Fabric Network Setup

Fabric Demo on IBM Blockchain Cloud

**Week 6**

Fabric Demo on IBM Blockchain Cloud continued..

Fabric Demo, deploy from scratch

Hyperledger Composer – Application Development

Hyperledger Composer – Network Administration

Blockchain Use Cases

**Week 7**

Blockchain in Financial Service(Payments and Secure Trading, Compliance and Mortgage, Financial Trade)

Revolutionizing Global Trade

Blockchain in Supply Chain

**Week 8**

Blockchain in Supply Chain Continued..

Blockchain in Other Industries

Blockchain in Government (Advantages, Use Cases, Digital Identity)

**Week 9**

Blockchain in Government(Hyperledger Indy, Tax Payments and Land Registry Records)

Blockchain Security (Overview, Membership and Access control in Fabric,Privacy in Fabric)

**Week 10**

Blockchain Security(Fabric SideDB)

Research Aspects(Consensus Scalability, Bitcoin-NG, Collective Signing, Byzcoin)

**Week 11**

Research Aspects(Algorand,Cross Fault Tolerance, Secured Multi-Party Computation)

Blockchain for Science (Blockchain for Big Data,Blockchain and AI)

**Week 12**

Comparing Ecosystems – Ethereum

Comparing Ecosystems – Ethereum development tools and Quorum

Comparing Ecosystems – Corda Part 1

Comparing Ecosystems – Corda Part 2

Concluding the course

Books and references

**Books**

* Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
* Blockchain by Melanie Swa, O’Reilly
* Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
* Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

**Hands-On Blockchain with Hyperledger**

* Publisher: https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger
* Amazon (Kindle and Paperback): https://www.amazon.com/Hands-Blockchain-Hyperledger-decentralized-applications/dp/1788994523
* Public github repository with code samples: <https://github.com/HyperledgerHandsOn/trade-finance-logistics>

# 11) **Discrete Mathematics**

* Course layout
* **Week 1:**  Counting
* **Week 2:**  Set Theory
* **Week 3:** Logic
* **Week 4:** Relations
* **Week 5:**  Functions
* **Week 6:**  Mathematical Induction and Pegionhole Principle
* **Week 7:** Graph Theory - 01
* **Week 8:** Graph Theory - 02
* **Week 9:** Graph Theory - 03 and Generating Functions
* **Week 10:**Principle of Inclusion-Exclusion
* **Week 11:**Recurrence relations
* **Week 12:**Advanced Topics

**12) Product Design and Innovation**

ourse layout

**Week 1:**  Introduction to Innovation, Design Inspired Innovation and User Innovation,Product Design

**Week 2:** Introduction to User Study- Problem and Need Identification, Contextual Enquiry, Physical Model

**Week 3:** Importance and overview of Human Factors/ Ergonomics in Product Design, Physical ergonomics Principles and Issues, Cognitive and Emotional Aspects of Human Factors with respect to Product Design

**Week 4**: Creative Techniques and Tools for Concept Generation and Concept Evaluation in Product Design,Tools and Techniques for Prototyping,Evaluation Tools and Techniques for User-Product Interaction

# **13) English Language for Competitive Exams**

Course layout

1. Introduction/Practice Tests
2. Advanced Grammar
3. Advanced Grammar for Competitive Exams
4. Advanced Vocabulary for Competitive Exams
5. Advanced Vocabulary
6. Advanced Reading for Competitive Exams
7. Advanced Reading for Competitive Exams
8. Advanced Writing for Competitive Exams
9. Conclusion

**14) Developing Soft Skills and Personality**

Course layout

**Week 1:** Lecture 1: Introduction: A New Approach To Learning

        Lecture 2: Planning And Goal-Setting

        Lecture 3: Human Perceptions: Understanding People

        Lecture 4: Types Of Soft Skills: Self-Management Skills

        Lecture 5: Aiming For Excellence: Developing Potential And Self-Actualisation

        Lecture 6: Need Achievement And Spiritual Intelligence

**Week 2:** Lecture 7: Conflict Resolution Skills: Seeking Win-Win Solution

        Lecture 8: Inter-Personal Conflicts: Two Examples

       Lecture 9: Inter-Personal Conflicts: Two Solutions

        Lecture 10: Types Of Conflicts: Becoming A Conflict Resolution Expert

        Lecture 11: Types Of Stress: Self-Awareness About Stress

        Lecture 12: Regulating Stress: Making The Best Out Of Stress

**Week 3:** Lecture 13: Habits: Guiding Principles

        Lecture 14: Habits: Identifying Good And Bad Habits

        Lecture 15: Habits: Habit Cycle

       Lecture 16: Breaking Bad Habits

        Lecture 17: Using The Zeigarnik Effect For Productivity And Personal Growth

       Lecture 18: Forming Habits Of Success

**Week 4:** Lecture 19: Communication: Significance Of Listening

       Lecture 20:Communication: Active Listening

       Lecture 21:Communication: Barriers To Active Listening

         Lecture 22:Telephone Communication: Basic Telephone Skills

        Lecture 23:Telephone Communication: Advanced Telephone Skills

        Lecture 24: Telephone Communication: Essential Telephone Skills

**Week 5:** Lecture 25: Technology And Communication: Technological Personality

       Lecture 26: Technology And Communication: Mobile Personality?

       Lecture 27: Topic: Technology And Communication: E-Mail Principles

       Lecture 28: Technology And Communication: How Not To Send E-Mails!

       Lecture 29: Technology And Communication: Netiquette

       Lecture 30: Technology And Communication: E-Mail Etiquette

**Week 6:** Lecture 31: Communication Skills: Effective Communication

       Lecture 32: Barriers To Communication: Arising Out Of Sender/Receiver’s Personality

       Lecture 33: Barriers To Communication: Interpersonal Transactions

        Lecture 34: Barriers To Communication: Miscommunication

       Lecture 35: Non-Verbal Communication: Pre-Thinking Assessment-1

       Lecture 36: Non-Verbal Communication: Pre-Thinking Assessment-2

**Week 7:** Lecture 37: Nonverbal Communication: Introduction And Importance

       Lecture 38: Non-Verbal Communication: Issues And Types

       Lecture 39: Non-Verbal Communication: Basics And Universals

       Lecture 40: Non-Verbal Communication: Interpreting Non-Verbal Cues

       Lecture 41: Body Language: For Interviews

       Lecture 42: Body Language: For Group Discussions

**Week 8:** Lecture 43: Presentation Skills: Overcoming Fear

       Lecture 44: Presentation Skills: Becoming A Professional

       Lecture 45: Presentation Skills: The Role Of Body Language

       Lecture 46: Presentation Skills: Using Visuals

       Lecture 47: Reading Skills: Effective Reading

        Lecture 48: Human Relations: Developing Trust And Integrity

Books and references

1. Dorch, Patricia. *What Are Soft Skills*? New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. *Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders*. Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman & Molly Hamaker. *The Hard Truth about Soft Skills*. London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. *Soft Skills and Professional Communication*. New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book.  *The EQ Edge: Emotional Intelligence and Your Success*. Canada: Wiley & Sons, 2006.

15) Gender justice and workplace security

Course layout

 **Week 1:**Introduction to Gender Justice- Notion and Significance

**Week 2:** International and Constitutional Perspectives on Gender Equality

**Week 3:** Protection  of Women at Workplace

**Week 4:** Gender Violence- Within and Beyond

**16) Cognition, Transformation and Lives**

Course layout

**Week 1:** Why Do people do what they do?

**Week 2:**Where is the mind?

**Week 3:**Understanding Transformation

**Week 4:** Gandhi’s process of transformation.

**17) Refrigeration And Air-Conditioning**

Course layout

**Week-1** : Recapitulation of Thermodynamics, Introduction to Refrigeration, Air Refrigeration Cycle, Aircraft Refrigeration Cycles.

**Week-2** : Aircraft Refrigeration Cycles,Vapour Compression Cycle,P-h Charts, Actual Vapour Compression Cycle

**Week-3** : Actual Vapour Compression Cycle,Compound Compression with Intercooling, Multiple Evaporator and Cascade System, Problem Solving

**Week-4** : Refrigerants, Vpour Absorption Systems.

**Week-5** : Introduction to Air-conditioning, Properties of Moist Air, Psychrometric Chart, Psychrometric Processes.

**Week-6** : Psychrometric Processes, Infiltration Design Conditions, Cooling Load.

**Week-7** : Cooling Load, Air Distribution System, Problem Solving, Air-Conditioning Systems

**Week-8** : Human Physiology, Thermal Comfort, Indoor Environmental Health, Problem Solving

**18) Principles of Metal Forming Technology**

Course layout

**Week 1** : Introduction and classification of metalworking processes, Behavior of materials
**Week 2**:  Concept of stress and strain, Hydrostatic and deviatoric stresses
**Week 3** : Flow curve Yield criteria for ductile materials, plastic stress strain relationships
**Week 4** :  Yielding and ductility during instability, Effect of strain rate and temperature on flow properties
**Week 5** :  mechanics of metalworking, Analysis methods, Hot and cold working
**Week 6** :  Introduction, classification and analysis of forging and rolling operations
**Week 7** :  Defects in rolled and forged components, Analysis of extrusion process
**Week 8** :  Classification and analysis of wire and tube drawing and sheetmetal working, Powder metallurgy forming

Books and references

1. Ghosh, A., and Mallik, A.K., Manufacturing Science, Affiliated East-West Press Pvt. Ltd.

2. Rowe, Geoffrey W., An introduction to the principles of Metal Working, TMH

3. Dieter George E., Mechanical Metallurgy, McGrawHill

**19)** Processing of Polymers and Polymer Composites

**Week 1:**  Introduction to course, Engineering materials and processing techniques, Thermoplastics and thermosets,
 Processing of polymers, Thermoforming process.
**Week 2:**  Extrusion, Compression molding, Injection molding.
**Week 3:**  Transfer molding, Rotational molding, Blow molding, Composite materials: basic concepts, Classification of composite materials.
**Week 4:**  Processing of polymer composites, Hand-layup, Spray-layup, Compression molding Injection molding.
**Week 5:**  Reaction injection molding, Autoclaving, Resin transfer molding, Filament winding, Pultrusion.
**Week 6:**  Sheet molding, Pre-pegging and challenges in primary processing of composites, Secondary processing of polymer
 composites, Joining of polymer composites, Adhesive joining.
**Week 7:**  Mechanical joining, Microwave joining, Induction and resistance welding, Drilling of polymer composites.
**Week 8:**  Conventional vs ultrasonic drilling, Remedies for reducing drilling induce damages, Research tools for secondary processing,
 Numerical problems and case studies.

# 20) **Introduction to Abrasive Machining and Finishing Processes**

Course layout

**Week 1** :  Introduction conventional abrasive processes,Introduction to abrasive processes,Grinding Process
**Week 2**: Conventional abrasive finishing processes (CAFP): Honing & Wire Brushing,CAFP: Lapping, Buffing & Super finishing,Practical Conventional abrasive finishing processes
**Week 3** : Adv. abrasive machining processes (AAMP),AAMP
**Week 4** : Hybrid Adv. Abrasive Machining Processes,Advanced Finishing
**Week 5** : Adv. Finishing: Abrasive Flow Finishing
**Week 6** : Adv. Finishing: Magnetic Abrasive Finishing
**Week 7** : Adv. Finishing: Magnetic Rheological Finishing
**Week 8** : Hybrid abrasive finishing,Finishing of Advanced Materials

**21) Leadership**

 **Week 1:**   Introduction to Leadership: Functions; Leadership Roles: Leaders Vs Managers: Theories

**Week 2:**Leadership Styles: Effective Vs Successful Managers; Leadership Styles: Adaptation - Studies / Case: “From Sindhi to Siddhi” (Part - I)

         Leadership Behaviour: Emergence: Leadership and Trust; Case: “From Sindhi to Siddhi (Part-II)”/ Transformation Leadership.

**Week 3:**   Leadership Skills: Leadership and Management; Case: The DVC story - A First Person Account Leadership in Action - (Part - I)

                Competencies and Skills of Leaders: Issues in Organizational Leadership; Case: The DVC Story - A First Person Account

                Leadership in Action Part – II

**Week 4:**  Self Regulating - The Key to Institution Building

                Framework of institution Building; Case: “Rai Bahadur Mohan Singh Oberoi” (Part - I)

                Issues in Institution Building;

                Case: Rai Bahadur Mohan Singh Oberoi (Part-II)

**22)** Data Analysis and Decision Making – I

Course layout

**Week 1**  :  Introduction to Multivariate Analysis

**Week 2**  :  Joint and marginal Distribution

**Week 3**  :  Multinomial, Multivariate Normal, Multivariate t, Wishart and other Distributions

**Week 4**  :  Multivariate Extreme Valued Distributions

**Week 5**  :  Copula Method

**Week 6**  :  Multiple Linear Regression, Multiple Non-Linear Regression, etc.

**Week 7**  :  Factor Analysis

**Week 8**  :  MANOVA, MANCOVA, etc.

**Week 9**  :  Conjoint Analysis

**Week 10** :  Cluster Analysis

**Week 11** :  Multiple Discriminant Analysis

**Week 12** :  Multidimensional Scaling, Structural Equation Modeling