CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship

LIFE SCIENCES

1. Molecules and their Interaction Relevant to Biology
2. Cellular Organization
3. Fundamental Processes
4. Cell Communication and Cell Signaling
5. Developmental Biology
6. System Physiology – Plant
7. System Physiology – Animal
8. Inheritance Biology
9. Diversity of Life Forms
10. Ecological Principles
11. Evolution and Behavior
12. Applied Biology
13. Methods in Biology

1. MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY

A. Structure of atoms, molecules and chemical bonds.
B Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
C. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).
D Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
E. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
F. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
G. Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).
H. Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).
I. Stability of proteins and nucleic acids.
J. Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

A) **Membrane structure and function**
(Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport,electrical properties of membranes).

B) **Structural organization and function of intracellular organelles** (Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility).

C) **Organization of genes and chromosomes (**Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons).

D) **Cell division and cell cycle** (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).

E) **Microbial Physiology** (Growth yield and characteristics, strategies of cell division, stress response)

3. FUNDAMENTAL PROCESSES

A) **DNA replication, repair and recombination** (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

B) **RNA synthesis and processing** (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping,

elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

C) **Protein synthesis and processing** (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post- translational modification of proteins).

D) **Control of gene expression at transcription and translation level** (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

4. Cell communication and cell signaling

A) **Host parasite interaction** Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

B) **Cell signaling** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

C) **Cellular communication** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

D) **Cancer**
Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

E) **Innate and adaptive immune system** Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

5. DEVELOPMENTAL BIOLOGY

A) Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

B) Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

C) Morphogenesis and organogenesis in animals : Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

D) Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*

E) Programmed cell death, aging and senescence

6. SYSTEM PHYSIOLOGY - PLANT

A. Photosynthesis - Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C_3, C_4 and CAM pathways.

B. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

C. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis.

D. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

E. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

F. **Solute transport and photoassimilate translocation –** uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

G. **Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

H. **Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

7. **SYSTEM PHYSIOLOGY - ANIMAL**

A. **Blood and circulation** - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

B. **Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

C. **Respiratory system** - Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

D. **Nervous system** - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

E. **Sense organs** - Vision, hearing and tactile response.

F. **Excretory system** - Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

G. **Thermoregulation** - Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

H. **Stress and adaptation**

I. **Digestive system** - Digestion, absorption, energy balance, BMR.

J. **Endocrinology and reproduction** - Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

8. INHERITANCE BIOLOGY

A) Mendelian principles : Dominance, segregation, independent assortment.

B) Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests

C) Extensions of Mendelian principles : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

D) Gene mapping methods : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

E) Extra chromosomal inheritance : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

F) Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

G) Human genetics : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.

H) Quantitative genetics : Polygenic inheritance, heritability and its measurements, QTL mapping.

I) Mutation : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal verses somatic mutants, insertional mutagenesis.

J) Structural and numerical alterations of chromosomes : Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

K) Recombination : Homologous and non-homologous recombination including transposition.

9. DIVERSITY OF LIFE FORMS:

A. Principles & methods of taxonomy:

Concepts of species and hierarchical taxa, biological nomenclature, classical & quantititative methods of taxonomy of plants, animals and microorganisms.

B. Levels of structural organization:

Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.

C. **Outline classification of plants, animals & microorganisms:**
Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.

D. **Natural history of Indian subcontinent:**
Major habitat types of the subcontinent, geographic origins and migrations of species. Comman Indian mammals, birds. Seasonality and phenology of the subcontinent.

E. **Organisms of health & agricultural importance:**
Common parasites and pathogens of humans, domestic animals and crops.

F. **Organisms of conservation concern:**

Rare, endangered species. Conservation strategies.

10. ECOLOGICAL PRINCIPLES

The Environment: Physical environment; biotic environment; biotic and abiotic interactions.

Habitat and Niche: Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (*r* and *K* selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

Species Interactions: Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

Community Ecology: Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

Ecological Succession: Types; mechanisms; changes involved in succession; concept of climax.

Ecosystem Ecology: Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

Biogeography: Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

Applied Ecology: Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.

Conservation Biology: Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

11. EVOLUTION AND BEHAVIOUR

A. Emergence of evolutionary thoughts

Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

B. Origin of cells and unicellular evolution:

Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

C. Paleontology and Evolutionary History:

The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.

D. Molecular Evolution:

Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

E. The Mechanisms:

Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

F. Brain, Behavior and Evolution:

Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis

of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

12. **APPLIED BIOLOGY:**

A. Microbial fermentation and production of small and macro molecules.

B. Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals.

C. Transgenic animals and plants, molecular approaches to diagnosis and strain identification.

D. Genomics and its application to health and agriculture, including gene therapy.

E. Bioresource and uses of biodiversity.

F. Breeding in plants and animals, including marker – assisted selection

G. Bioremediation and phytoremediation

H. Biosensors

13. METHODS IN BIOLOGY

A. Molecular Biology and Recombinant DNA methods:

Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods.
Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels.
Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems.
Expression of recombinant proteins using bacterial, animal and plant vectors.
Isolation of specific nucleic acid sequences
Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.
In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.
Protein sequencing methods, detection of post translation modification of proteins.
DNA sequencing methods, strategies for genome sequencing.
Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques
Isolation, separation and analysis of carbohydrate and lipid molecules
RFLP, RAPD and AFLP techniques

B. Histochemical and Immunotechniques

Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

C Biophysical Method:

Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

D Statisitcal Methods:

Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X^2 test;; Basic introduction to Muetrovariate statistics, etc.

E. **Radiolabeling techniques:**

Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

F. **Microscopic techniques:**

Visulization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

G. **Electrophysiological methods:**

Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT .

H. **Methods in field biology:**

Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods..

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CHEMICAL SCIENCES

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.

2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.

3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.

4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.

5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.

7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.

8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.

9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.

12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

13. Polymer chemistry: Molar masses; kinetics of polymerization.

14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.

2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.

3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.

4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.

5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.

6. Common named reactions and rearrangements – applications in organic synthesis.

7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.

8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.

9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.

10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.

11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).

12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.

13. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR and Mass spectroscopic techniques.

Interdisciplinary topics

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.

UNIVERSITY GRANTS COMMISSION
NET BUREAU

NET SYLLABUS

Subject : COMPUTER SCIENCE AND APPLICATIONS

Code No.:(87)

Unit - 1 : Discrete Structures and Optimization

Mathematical Logic: Propositional and Predicate Logic, Propositional Equivalences, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference.

Sets and Relations: Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering.

Counting, Mathematical Induction and Discrete Probability: Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction, Probability, Bayes' Theorem.

Group Theory: Groups, Subgroups, Semi Groups, Product and Quotients of Algebraic Structures, Isomorphism, Homomorphism, Automorphism, Rings, Integral Domains, Fields, Applications of Group Theory.

Graph Theory: Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets.

Boolean Algebra: Boolean Functions and its Representation, Simplifications of Boolean Functions.

Optimization: Linear Programming - Mathematical Model, Graphical Solution, Simplex and Dual Simplex Method, Sensitive Analysis; Integer Programming, Transportation and Assignment Models, PERT-CPM: Diagram Representation, Critical Path Calculations, Resource Levelling, Cost Consideration in Project Scheduling.

Unit - 2 : Computer System Architecture

Digital Logic Circuits and Components: Digital Computers, Logic Gates, Boolean Algebra, Map Simplifications, Combinational Circuits, Flip-Flops, Sequential Circuits, Integrated Circuits, Decoders, Multiplexers, Registers and Counters, Memory Unit.

Data Representation: Data Types, Number Systems and Conversion, Complements, Fixed Point Representation, Floating Point Representation, Error Detection Codes, Computer Arithmetic - Addition, Subtraction, Multiplication and Division Algorithms.

Register Transfer and Microoperations: Register Transfer Language, Bus and Memory Transfers, Arithmetic, Logic and Shift Microoperations.

Basic Computer Organization and Design: Stored Program Organization and Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input-Output, Interrupt.

Programming the Basic Computer: Machine Language, Assembly Language, Assembler, Program Loops, Subroutines, Input-Output Programming.

Microprogrammed Control: Control Memory, Address Sequencing, Design of Control Unit.

Central Processing Unit: General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer.

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, Vector Processing Array Processors.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication.

Memory Hierarchy: Main Memory, Auxillary Memory, Associative Memory, Cache Memory, Virtual Memory, Memory Management Hardware.

Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Interprocessor Arbitration, Interprocessor Communication and Synchronization, Cache Coherence, Multicore Processors.

Unit - 3 : Programming Languages and Computer Graphics

Language Design and Translation Issues: Programming Language Concepts, Paradigms and Models, Programming Environments, Virtual Computers and Binding Times, Programming Language Syntax, Stages in Translation, Formal Transition Models.

Elementary Data Types: Properties of Types and Objects; Scalar and Composite Data Types.

Programming in C: Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Argumaents, Preprocessors.

Object Oriented Programming: Class, Object, Instantiation, Inheritance, Encapsulation, Abstract Class, Polymorphism.

Programming in C++: Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions, Class and Objects; Constructors and Destructors; Overloading, Inheritance, Templates, Exception and Event Handling; Streams and Files; Multifile Programs.

Web Programming: HTML, DHTML, XML, Scripting, Java, Servlets, Applets.

Computer Graphics: Video-Display Devices, Raster-Scan and Random-Scan Systems; Graphics Monitors, Input Devices, Points and Lines; Line Drawing Algorithms, Mid-Point Circle and Ellipse Algorithms; Scan Line Polygon Fill Algorithm, Boundary-Fill and Flood-Fill.

2-D Geometrical Transforms and Viewing: Translation, Scaling, Rotation, Reflection and Shear Transformations; Matrix Representations and Homogeneous Coordinates; Composite Transforms, Transformations Between Coordinate Systems, Viewing Pipeline, Viewing Coordinate Reference Frame, Window to View-Port Coordinate Transformation, Viewing Functions, Line and Polygon Clipping Algorithms.

3-D Object Representation, Geometric Transformations and Viewing: Polygon Surfaces, Quadric Surfaces, Spline Representation, Bezier and B-Spline Curves; Bezier and B-Spline Surfaces; Illumination Models, Polygon Rendering Methods, Viewing Pipeline and Coordinates; General Projection Transforms and Cipping.

Unit – 4 : Database Management Systems

Database System Concepts and Architecture: Data Models, Schemas, and Instances; Three-Schema Architecture and Data Independence; Database Languages and Interfaces; Centralized and Client/Server Architectures for DBMS.

Data Modeling: Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations and Dealing with Constraint Violations; Relational Algebra and Relational Calculus; Codd Rules.

SQL: Data Definition and Data Types; Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions; Database Triggers, SQL Injection.

Normalization for Relational Databases: Functional Dependencies and Normalization; Algorithms for Query Processing and Optimization; Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques, Object and Object-Relational Databases; Database Security and Authorization.

Enhanced Data Models: Temporal Database Concepts, Multimedia Databases, Deductive Databases, XML and Internet Databases; Mobile Databases, Geographic Information Systems, Genome Data Management, Distributed Databases and Client-Server Architectures.

Data Warehousing and Data Mining: Data Modeling for Data Warehouses, Concept Hierarchy, OLAP and OLTP; Association Rules, Classification, Clustering, Regression,

Support Vector Machine, K-Nearest Neighbour, Hidden Markov Model, Summarization, Dependency Modeling, Link Analysis, Sequencing Analysis, Social Network Analysis.

Big Data Systems: Big Data Characteristics, Types of Big Data, Big Data Architecture, Introduction to Map-Reduce and Hadoop; Distributed File System, HDFS.
NOSQL: NOSQL and Query Optimization; Different NOSQL Products, Querying and Managing NOSQL; Indexing and Ordering Data Sets; NOSQL in Cloud.

Unit – 5 : System Software and Operating System

System Software: Machine, Assembly and High-Level Languages; Compilers and Interpreters; Loading, Linking and Relocation; Macros, Debuggers.

Basics of Operating Systems: Operating System Structure, Operations and Services; System Calls, Operating-System Design and Implementation; System Boot.
Process Management: Process Scheduling and Operations; Interprocess Communication, Communication in Client–Server Systems, Process Synchronization, Critical-Section Problem, Peterson's Solution, Semaphores, Synchronization.

Threads: Multicore Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues.

CPU Scheduling: Scheduling Criteria and Algorithms; Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling.

Deadlocks: Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection; Recovery from Deadlock.

Memory Management: Contiguous Memory Allocation, Swapping, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing, Memory-Mapped Files.

Storage Management: Mass-Storage Structure, Disk Structure, Scheduling and Management, RAID Structure.

File and Input/Output Systems: Access Methods, Directory and Disk Structure; File-System Mounting, File Sharing, File-System Structure and Implementation; Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance; Recovery, I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Requests to Hardware Operations.

Security: Protection, Access Matrix, Access Control, Revocation of Access Rights, Program Threats, System and Network Threats; Cryptography as a Security Tool, User Authentication, Implementing Security Defenses.

Virtual Machines: Types of Virtual Machines and Implementations; Virtualization.

Linux Operating Systems: Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output; Interprocess Communication, Network Structure.

Windows Operating Systems: Design Principles, System Components, Terminal Services and Fast User Switching; File System, Networking.

Distributed Systems: Types of Network based Operating Systems, Network Structure, Communication Structure and Protocols; Robustness, Design Issues, Distributed File Systems.

Unit – 6 : Software Engineering

Software Process Models: Software Process, Generic Process Model – Framework Activity, Task Set and Process Patterns; Process Lifecycle, Prescriptive Process Models, Project Management, Component Based Development, Aspect-Oriented Software Development, Formal Methods, Agile Process Models – Extreme Programming (XP), Adptive Software Development, Scrum, Dynamic System Development Model, Feature Driven Development, Crystal, Web Engineering**.**

Software Requirements: Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software Requirment and Specification (SRS) Document.

Software Design: Abstraction, Architecture, Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Cohesion and Coupling; Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

Software Quality: McCall's Quality Factors, ISO 9126 Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM); Software Reliability.

Estimation and Scheduling of Software Projects: Software Sizing, LOC and FP based Estimations; Estimating Cost and Effort; Estimation Models, Constructive Cost Model (COCOMO), Project Scheduling and Staffing; Time-line Charts.

Software Testing: Verification and Validation; Error, Fault, Bug and Failure; Unit and Integration Tesing; White-box and Black-box Testing; Basis Path Testing, Control Structure Testing, Deriving Test Cases, Alpha and Beta Testing; Regression Testing, Performance Testing, Stress Testing.

Software Configuration Management: Change Control and Version Control; Software Reuse, Software Re-engineering, Reverse Engineering.

Unit – 7 : Data Structures and Algorithms

Data Structures: Arrays and their Applications; Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists, Trees, Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, B* Tree, Data Structure for Sets, Graphs, Sorting and Searching Algorithms; Hashing.

Performance Analysis of Algorithms and Recurrences: Time and Space Complexities; Asymptotic Notation, Recurrence Relations.

Design Techniques: Divide and Conquer; Dynamic Programming, Greedy Algorithms, Backtracking, Branch and Bound.

Lower Bound Theory: Comparison Trees, Lower Bounds through Reductions.

Graph Algorithms: Breadth-First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees.

Complexity Theory: P and NP Class Problems; NP-completeness and Reducibility.

Selected Topics: Number Theoretic Algorithms, Polynomial Arithmetic, Fast Fourier Transform, String Matching Algorithms.

Advanced Algorithms: Parallel Algorithms for Sorting, Searching and Merging, Approximation Algorithms, Randomized Algorithms.

Unit – 8 : Theory of Computation and Compilers

Theory of Computation: Formal Language, Non-Computational Problems, Diagonal Argument, Russels's Paradox.

Regular Language Models: Deterministic Finite Automaton (DFA), Non-Deterministic Finite Automaton (NDFA), Equivalence of DFA and NDFA, Regular Languages, Regular Grammars, Regular Expressions, Properties of Regular Language, Pumping Lemma, Non-Regular Languages, Lexical Analysis.

Context Free Language: Pushdown Automaton (PDA), Non-Deterministic Pushdown Automaton (NPDA), Context Free Grammar, Chomsky Normal Form, Greibach Normal Form, Ambiguity, Parse Tree Representation of Derivation Trees, Equivalence of PDA's and Context Free Grammars; Properties of Context Free Language.

Turing Machines (TM): Standard Turing Machine and its Variations; Universal Turing Machines, Models of Computation and Church-Turing Thesis; Recursive and Recursively-Enumerable Languages; Context-Sensitive Languages, Unrestricted Grammars, Chomsky Hierarchy of Languages, Construction of TM for Simple Problems.

Unsolvable Problems and Computational Complexity: Unsolvable Problem, Halting Problem, Post Correspondence Problem, Unsolvable Problems for Context-Free Languages, Measuring and Classifying Complexity, Tractable and Intractable Problems.

Syntax Analysis: Associativity, Precedence, Grammar Transformations, Top Down Parsing, Recursive Descent Predictive Parsing, LL(1) Parsing, Bottom up Parsing, LR Parser, LALR(1) Parser.

Semantic Analysis: Attribute Grammar, Syntax Directed Definitions, Inherited and Synthesized Attributes; Dependency Graph, Evaluation Order, S-attributed and L-attributed Definitions; Type-Checking.

Run Time System: Storage Organization, Activation Tree, Activation Record, Stack Allocation of Activation Records, Parameter Passing Mechanisms, Symbol Table.

Intermediate Code Generation: Intermediate Representations, Translation of Declarations, Assignments, Control Flow, Boolean Expressions and Procedure Calls.

Code Generation and Code Optimization: Control-flow, Data-flow Analysis, Local Optimization, Global Optimization, Loop Optimization, Peep-Hole Optimization, Instruction Scheduling.

Unit – 9 : Data Communication and Computer Networks

Data Communication: Components of a Data Communication System, Simplex, Half-Duplex and Duplex Modes of Communication; Analog and Digital Signals; Noiseless and Noisy Channels; Bandwidth, Throughput and Latency; Digital and Analog Transmission; Data Encoding and Modulation Techniques; Broadband and Baseband Transmission; Multiplexing, Transmission Media, Transmission Errors, Error Handling Mechanisms.

Computer Networks: Network Topologies, Local Area Networks, Metropolitan Area Networks, Wide Area Network, Wireless Networks, Internet.

Network Models: Layered Architecture, OSI Reference Model and its Protocols; TCP/IP Protocol Suite, Physical, Logical, Port and Specific Addresses; Switching Techniques.

Functions of OSI and TCP/IP Layers: Framing, Error Detection and Correction; Flow and Error Control; Sliding Window Protocol, HDLC, Multiple Access – CSMA/CD, CSMA/CA, Reservation, Polling, Token Passing, FDMA, CDMA, TDMA, Network Devices, Backbone Networks, Virtual LANs.
IPv4 Structure and Address Space; Classful and Classless Addressing; Datagram, Fragmentation and Checksum; IPv6 Packet Format, Mapping Logical to Physical Address (ARP), Direct and Indirect Network Layer Delivery; Routing Algorithms, TCP, UDP and SCTP Protocols; Flow Control, Error Control and Congestion Control in TCP and SCTP.

World Wide Web (WWW): Uniform Resource Locator (URL), Domain Name Service (DNS), Resolution - Mapping Names to Addresses and Addresses to Names; Electronic Mail Architecture, SMTP, POP and IMAP; TELNET and FTP.

Network Security: Malwares, Cryptography and Steganography; Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls.

Mobile Technology: GSM and CDMA; Services and Architecture of GSM and Mobile Computing; Middleware and Gateway for Mobile Computing; Mobile IP and Mobile Communication Protocol; Communication Satellites, Wireless Networks and Topologies; Cellular Topology, Mobile Adhoc Networks, Wireless Transmission and Wireless LANs; Wireless Geolocation Systems, GPRS and SMS.

Cloud Computing and IoT: SaaS, PaaS, IaaS, Public and Private Cloud; Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics of IoT.

Unit – 10 : Artificial Intelligence (AI)

Approaches to AI: Turing Test and Rational Agent Approaches; State Space Representation of Problems, Heuristic Search Techniques, Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures.

Knowledge Representation: Logic, Semantic Networks, Frames, Rules, Scripts, Conceptual Dependency and Ontologies; Expert Systems, Handling Uncertainty in Knowledge.

Planning: Components of a Planning System, Linear and Non Linear Planning; Goal Stack Planning, Hierarchical Planning, STRIPS, Partial Order Planning.

Natural Language Processing: Grammar and Language; Parsing Techniques, Semantic Analysis and Prgamatics.
Multi Agent Systems: Agents and Objects; Agents and Expert Systems; Generic Structure of Multiagent System, Semantic Web, Agent Communication, Knowledge Sharing using Ontologies, Agent Development Tools.

Fuzzy Sets: Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification; Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference; Fuzzy Control System and Fuzzy Rule Based Systems.

Genetic Algorithms (GA): Encoding Strategies, Genetic Operators, Fitness Functions and GA Cycle; Problem Solving using GA.

Artificial Neural Networks (ANN): Supervised, Unsupervised and Reinforcement Learning; Single Perceptron, Multi Layer Perceptron, Self Organizing Maps, Hopfield Network.

UNIVERSITY GRANTS COMMISSION
NET BUREAU

NET SYLLABUS

Subject: ELECTRONIC SCIENCE Code No. : (88)

UNIT-I

Introduction to Semiconductor, energy bands in solids, concept of effective mass, density of states, Fermi levels. PN Junction, Diode equation and diode equivalent circuit, Breakdown in diodes, Zener diode, Tunnel diode, Metal semiconductor junction – Ohmic and Schottky contacts, Characteristics and equivalent circuits of JFET, MOSFET. Low dimensional semiconductor devices – quantum wells, quantum wires, quantum dots. High Electron Mobility Transistor (HEMT), Solar cells – I-V characteristics, fill factor and efficiency, LED, LCD and flexible display devices.
Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc.

UNIT-II

IC fabrication – crystal growth, epitaxy, oxidation, lithography, doping, etching, isolation methods, metallization, bonding, Thin film deposition and characterization Techniques: XRD, TEM, SEM, EDX, Thin film active and passive devices, MOS technology and VLSI, scaling of MOS devices, NMOS and CMOS structures and fabrication, Characteristics of MOS transistors and threshold voltage, NMOS and CMOS inverters, Charge-Coupled Device (CCD) – structure, charge storage and transfer, Basics of VLSI design, stick diagrams, Layout design rules.

UNIT-III

Superposition, Thevenin, Norton and Maximum Power Transfer Theorems, Network elements, Network graphs, Nodal and Mesh analysis. Laplace Transform, Fourier Transform and Z-transform. Time and frequency domain response, Passive filters, Two-port Network Parameters : Z, Y, ABCD and h parameters, Transfer functions, Signal representation, State variable method of circuit analysis, AC circuit analysis, Transient analysis, Zero and Poles, Bode Plots.

Continuous time signals, Fourier Series and Fourier transform representations, Sampling theorem and applications, Discrete time signal, Discrete Fourier transform (DFT), Fast Fourier transform (FFT), Basic concepts of digital signal processing, digital filters – IIR, FIR.

UNIT – IV

Rectifiers, Voltage regulated ICs and regulated power supply, Biasing of Bipolar junction transistors and FETs, operating point and stability, Amplifiers, Classification of amplifiers, Concept of feedback, Hartley, Colpitt's and Phase Shift oscillators, Operational amplifiers (OPAMP) - characteristics, computational applications, comparators, Schmitt trigger, Instrumentation amplifiers, wave shaping circuits, Phase locked loops, Active filters, Multivibrators, Voltage to frequency convertors (V/F), frequency to voltage convertors (F/V).

UNIT-V

Logic Families, Logic Gates, Boolean algebra and minimization techniques, Combinational circuits, Programmable Logic Devices (PLD), CPLD, flip-flops, memories, Sequential Circuits: Counters – Ring, Ripple, Synchronous, Asynchronous, Shift registers, multiplexers and demultiplexers, A/D and D/A converters, Analysis and Design of fundamental mode state machines: State variables, State table and State diagram. Sequential PLD, FPGA, Analysis and Design of digital circuits using HDL.

UNIT-VI

Introduction of Microprocessor 8086: Architecture, Addressing modes, instruction set, interrupts, Programming, Memory and I/O interfacing.
Introduction of Microcontrollers – 8051 for embedded systems, Architecture and register set of Microcontroller 8051, Addressing modes, Instruction set of 8051 – Data transfer instructions, Arithmetic instructions, Logic instructions, bit level and byte level control transfer instructions, 8051 assembly programming – stack operations, subroutines, interrupts, 8051 programming as timer/counter, 8051 serial communication, 8051 interfacing RS232, LED/LCD display, Keyboard , Stepper motor.

UNIT-VII

Electrostatics - vector calculus, Gauss's Law, Laplace and Poisson's equations, Magnetostatics – Biot Savert's law, Ampere's law and electromagnetic induction, Maxwell's equations and wave equations, Plane wave propagation in free space, dielectrics and conductors, Poynting theorem, Reflection and refraction, polarization, interference, coherence and diffraction, Transmission lines and waveguides – line equations, impedance, reflections and voltage standing wave ratio, rectangular waveguides. Antennas – retarded potential and Hertzian dipole, half wave antenna, antenna patterns, radiation intensity, gain, effective area and Frii's free space receiver power equation.

Microwave Sources and Devices -Reflex Klystron, Magnetron, TWT, Gunn diode, IMPATT diode, Crystal Detector and PIN diode.
Radar – block diagram of Radar, frequencies and power used, Radar range equation.

UNIT-VIII

Analog modulation and demodulation - AM, FM and PM, Principle of super heterodyne receiver, Random signals, noise, noise temperature and noise figure, Basic concepts of information theory, Error detection and correction, Digital modulation and demodulation – PCM, ASK, FSK, PSK, BPSK, QPSK and QAM, Time and Frequency-Division Multiplexing, Multiple Access techniques, Data Communications – Modems, Codes, Principles of Mobile and Satellite Communication, Optical communication, Optical sources - LED, spontaneous and stimulated emission, semiconductor Lasers, Detectors – PIN photodiodes, Avalanche photodiodes (APD), Optical fibers – attenuation and dispersion characteristics, Bandwidth, Wavelength division multiplexing.
Fundamentals of Internet of Things (IoT) for communication.

UNIT-IX

Power devices – characteristics of SCR, DIAC, TRIAC, power transistors, Protection of thyristors against over voltage and over current. SCR triggering - dv/dt and di/dt, triggering with single pulse and train of pulses, A.C. and D.C. motors - construction and speed control. Switched Mode Power Supply (SMPS). Uninterrupted Power Supply (UPS).
Open loop and closed loop control system, Block Diagram reduction techniques, transfer function and signal flow diagram, Stability criterion: Routh-Hurwitz and Nyquist plot, On-off controller, Proportional (P), Proportional-Integral (PI), Proportional-Derivative (PD), PID controllers.

UNIT – X

Transducers – Resistance, Inductance, Capacitance, Piezoelectric, Thermoelectric, Hall effect, Photoelectric, Measurement of displacement, velocity, acceleration, force, torque, strain, temperature, pressure, flow, humidity, thickness, pH. Measuring Equipment – Measurement of R, L and C, Bridge and Potentiometers, voltage, current, power, energy, frequency/time, phase, Digital Multimeters, CRO, Digital Storage Oscilloscope, Spectrum Analyzer., Biomedical Instruments – ECG, EEG, Blood Pressure Measurements, MEMS and its applications Sensors for IoT applications.

UNIVERSITY GRANTS COMMISSION
NET BUREAU

NET SYLLABUS

Subject : ENVIRONMENTAL SCIENCES **Code No.: (89)**

This syllabus contains ten units:

Unit-I: Fundamentals of Environmental Sciences

Unit-II: Environmental Chemistry

Unit-III: Environmental Biology

Unit-IV: Environmental Geosciences

Unit-V: Energy and Environment

Unit-VI: Environmental Pollution and Control

Unit-VII: Solid and Hazardous Waste Management

Unit-VIII: Environmental Assessment, Management and Legislation

Unit-IX: Statistical Approaches and Modelling in Environmental Sciences

Unit-X: Contemporary Environmental Issues

Unit-I: Fundamentals of Environmental Sciences

Definition, Principles and Scope of Environmental Science.

Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.

Laws of thermodynamics, heat transfer processes, mass and energy transfer across various interfaces, material balance.

Meteorological parameters - pressure, temperature, precipitation, humidity, mixing ratio, saturation mixing ratio, radiation and wind velocity, adiabatic lapse rate, environmental lapse rate. Wind roses.

Interaction between Earth, Man and Environment. Biogeographic provinces of the world and agro-climatic zones of India. Concept of sustainable development.

Natural resources and their assessment. Remote Sensing and GIS: Principles of remote sensing and GIS. Digital image processing and ground truthing. Application of remote sensing and GIS in land cover/land use planning and management (urban sprawling, vegetation study, forestry, natural resource), waste management and climate change.

Environmental education and awareness. Environmental ethics.

Unit-II: Environmental Chemistry

Fundamentals of Environmental Chemistry: Classification of elements, Stoichiometry, Gibbs' energy, chemical potential, chemical kinetics, chemical equilibria, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radioisotopes.

Composition of air. Particles, ions and radicals in the atmosphere. Chemical speciation. Chemical processes in the formation of inorganic and organic particulate matters, thermochemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry. Photochemical smog.

Hydrological cycle. Water as a universal solvent. Concept of DO, BOD and COD. Sedimentation, coagulation, flocculation, filtration, pH and Redox potential (Eh).

Inorganic and organic components of soils. Biogeochemical cycles – nitrogen, carbon, phosphorus and sulphur.

Toxic chemicals: Pesticides and their classification and effects. Biochemical aspects of heavy metals (Hg, Cd, Pb, Cr) and metalloids (As, Se). CO, O_3, PAN, VOC and POP. Carcinogens in the air.

Principles of analytical methods: Titrimetry, Gravimetry, Bomb Calorimetry, Chromatography (Paper Chromatography, TLC, GC and HPLC), Flame photometry, Spectrophotometry (UV-VIS, AAS, ICP-AES, ICP-MS), Electrophoresis, XRF, XRD, NMR, FTIR, GC-MS, SEM, TEM.

Unit-III: Environmental Biology

Ecology as an inter-disciplinary science. Origin of life and speciation. Human Ecology and Settlement.

Ecosystem Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, energy flow models, food chains and food webs. Biogeochemical cycles, Ecological succession. Species diversity, Concept of ecotone, edge effects, ecological habitats and niche. Ecosystem stability and factors affecting stability. Ecosystem services.

Basis of Ecosystem classification. Types of Ecosystem: Desert (hot and cold), forest, rangeland, wetlands, lotic, lentic, estuarine (mangrove), Oceanic.

Biomes: Concept, classification and distribution. Characteristics of different biomes: Tundra, Taiga, Grassland, Deciduous forest biome, Highland Icy Alpine Biome, Chapparal, Savanna, Tropical Rain forest.

Population ecology: Characteristics of population, concept of carrying capacity, population growth and regulations. Population fluctuations, dispersion and metapopulation. Concept of ‘r’ and ‘k’ species. Keystone species.

Community ecology: Definition, community concept, types and interaction - predation, herbivory, parasitism and allelopathy. Biological invasions.

Biodiversity and its conservation: Definition, types, importance of biodiversity and threats to biodiversity. Concept and basis of identification of 'Hotspots'; hotspots in India. Measures of biodiversity. Strategies for biodiversity conservation: *in situ*, *ex situ* and *in vitro* conservation. National parks, Sanctuaries, Protected areas and Sacred groves in India. Concepts of gene pool, biopiracy and bio-prospecting. Concept of restoration ecology. Extinct, Rare, Endangered and Threatened flora and fauna of India.

Concept of Industrial Ecology.

Toxicology and Microbiology: Absorption, distribution and excretion of toxic agents, acute and chronic toxicity, concept of bioassay, threshold limit value, margin of safety, therapeutic index, biotransformation. Major water borne diseases and air borne microbes.

Environmental Biotechnology: Bioremediation – definition, types and role of plants and microbes for *in situ* and *ex situ* remediation. Bioindicators, Biofertilizers, Biofuels and Biosensors.

Unit-IV: Environmental Geosciences

Origin of earth. Primary geochemical differentiation and formation of core, mantle, crust, atmosphere and hydrosphere. Concept of minerals and rocks. Formation of igneous and metamorphic rocks. Controls on formation of landforms - tectonic including plate tectonic and climatic. Concept of steady state and equilibrium, Energy budget of the earth. Earth's thermal environment and seasons. Coriolis force, pressure gradient force, frictional force, geo-strophic wind field, gradient wind. Climates of India, western disturbances, Indian monsoon, droughts, *El Nino*, *La Nina*. Concept of residence time and rates of natural cycles. Geophysical fields.

Weathering including weathering reactions, erosion, transportation and deposition of sediments. Soil forming minerals and process of soil formation, Identification and characterization of clay minerals, Soil physical and

chemical properties, soil types and climate control on soil formation, Cation exchange capacity and mineralogical controls.

Geochemical classification of elements, abundance of elements in bulk earth, crust, hydrosphere and biosphere. Partitioning of elements during surficial geologic processes, Geochemical recycling of elements. Paleoclimate.

Distribution of water in earth, hydrology and hydrogeology, major basins and groundwater provinces of India, Darcy's law and its validity, groundwater fluctuations, hydraulic conductivity, groundwater tracers, land subsidence, effects of excessive use of groundwater, groundwater quality. Pollution of groundwater resources, Ghyben-Herzberg relation between fresh-saline water.

Natural resource exploration and exploitation and related environmental concerns. Historical perspective and conservation of non-renewable resources.

Natural Hazards: Catastrophic geological hazards - floods, landslides, earthquakes, volcanism, avalanche, tsunami and cloud bursts. Prediction of hazards and mitigation of their impacts.

Unit-V: Energy and Environment

Sun as source of energy; solar radiation and its spectral characteristics. Fossil fuels: classification, composition, physico-chemical characteristics and energy content of coal, petroleum and natural gas. Shale oil, Coal bed Methane, Gas hydrates. Gross-calorific value and net-calorific value.

Principles of generation of hydro-power, tidal energy, ocean thermal energy conversion, wind power, geothermal energy, solar energy (solar collectors, photo-voltaic modules, solar ponds).

Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor – principles and types.

Bioenergy: methods to produce energy from biomass.

Environmental implications of energy use; energy use pattern in India and the world, emissions of CO_2 in developed and developing countries

including India, radiative forcing and global warming. Impacts of large scale exploitation of solar, wind, hydro and nuclear energy sources.

Unit-VI: Environmental Pollution and Control

Air Pollution:
Sources and types of Pollutants - Natural and anthropogenic sources, primary and secondary pollutants. Criteria air pollutants. Sampling and monitoring of air pollutants (gaseous and particulates); period, frequency and duration of sampling. Principles and instruments for measurements of (i) ambient air pollutants concentration and (ii) stack emissions. Indian National Ambient Air Quality Standards. Impact of air pollutants on human health, plants and materials. Acid rain. Dispersion of air pollutants. Mixing height/depth, lapse rates, Gaussian plume model, line source model and area source model. Control devices for particulate matter: Principle and working of: settling chamber, centrifugal collectors, wet collectors, fabric filters and electrostatic precipitator. Control of gaseous pollutants through adsorption, absorption, condensation and combustion including catalytic combustion. Indoor air pollution, Vehicular emissions and Urban air quality.

Noise Pollution:
Sources, weighting networks, measurement of noise indices (L_{eq}, L_{10}, L_{90}, L_{50}, L_{DN}, TNI). Noise dose and Noise Pollution standards. Noise control and abatement measures: Active and Passive methods. Vibrations and their measurements. Impact of noise and vibrations on human health.

Water Pollution:
Types and sources of water pollution. Impact on humans, plants and animals. Measurement of water quality parameters: sampling and analysis for pH, EC, turbidity, TDS, hardness, chlorides, salinity, DO, BOD, COD, nitrates, phosphates, sulphates, heavy metals and organic contaminants. Microbiological analysis – MPN. Indian standards for drinking water (IS:10500, 2012). Drinking water treatment: Coagulation and flocculation, Sedimentation and Filtration, Disinfection and Softening. Wastewater Treatment: Primary, Secondary and Advanced treatment methods. Common effluent treatment plant.

Soil Pollution:
Physico-chemical and biological properties of soil (texture, structure, inorganic and organic components). Analysis of soil quality. Soil Pollution control. Industrial effluents and their interactions with soil components. Soil micro-organisms and their functions - degradation of pesticides and synthetic fertilizers.

Thermal, Marine Pollution and Radioactive:
Sources of Thermal Pollution, Heat Islands, causes and consequences. Sources and impact of Marine Pollution. Methods of Abatement of Marine Pollution. Coastal management. Radioactive pollution – sources, biological effects of ionizing radiations, radiation exposure and radiation standards, radiation protection.

Unit-VII: Solid and Hazardous Waste Management

Solid Waste - types and sources. Solid waste characteristics, generation rates, solid waste components, proximate and ultimate analyses of solid wastes.

Solid waste collection and transportation: container systems - hauled and stationary, layout of collection routes, transfer stations and transportation.

Solid waste processing and recovery – Recycling, recovery of materials for recycling and direct manufacture of solid waste products. Electrical energy generation from solid waste (Fuel pellets, Refuse derived fuels), composting and vermicomposting, biomethanation of solid waste. Disposal of solid wastes – sanitary land filling and its management, incineration of solid waste.

Hazardous waste – Types, characteristics and health impacts. Hazardous waste management: Treatment Methods – neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal.

e-waste: classification, methods of handling and disposal.

Fly ash: sources, composition and utilisation.

Plastic waste: sources, consequences and management.

Unit-VIII: Environmental Assessment, Management and Legislation

Aims and objectives of Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS) and Environmental Management Plan (EMP). EIA Guidelines. Impact Assessment Methodologies. Procedure for reviewing EIA of developmental projects. Life-cycle analysis, cost-benefit analysis. Guidelines for Environmental Audit. Environmental Planning as a part of EIA and Environmental Audit. Environmental Management System Standards (ISO14000 series). EIA Notification, 2006 and amendments from time to time. Eco-labeling schemes.

Risk Assessment - Hazard identification, Hazard accounting, Scenarios of exposure, Risk characterization and Risk management.

Overview of Environmental Laws in India: Constitutional provisions in India (Article 48A and 51A). Wildlife Protection Act, 1972 amendments 1991, Forest Conservation Act, 1980, Indian Forest Act, Revised 1982, Biological Diversity Act, 2002, Water (Prevention and Control of Pollution) Act, 1974 amended 1988 and Rules 1975, Air (Prevention and Control of Pollution) Act, 1981 amended 1987 and Rules 1982, Environmental (Protection) Act, 1986 and Rules 1986, Motor Vehicle Act, 1988, The Hazardous and Other Waste (Management and Transboundary Movement) Rules, 2016, The Plastic Waste Management Rules, 2016, The Bio-Medical Waste Management Rules, 2016, The Solid Waste Management Rules, 2016, The e-waste (Management) Rules 2016, The Construction and Demolition Waste Management Rules, 2016, The Manufacture, Storage and Import of Hazardous Chemical (Amendment) Rules, 2000, The Batteries (Management and Handling) Rules, 2010 with Amendments, The Public Liability Insurance Act, 1991 and Rules 1991, Noise Pollution (Regulation

and Control) Rules, 2000, Coastal Regulation Zones (CRZ) 1991 amended from time to time.

National Forest Policy, 1988, National Water Policy, 2002, National Environmental Policy, 2006.

Environmental Conventions and Agreements: Stockholm Conference on Human Environment 1972, Montreal Protocol, 1987, Conference of Parties (COPs), Basel Convention (1989, 1992), Ramsar Convention on Wetlands (1971), Earth Summit at Rio de Janeiro, 1992, Agenda-21, Global Environmental Facility (GEF), Convention on Biodiversity (1992), UNFCCC, Kyoto Protocol, 1997, Clean Development Mechanism (CDM), Earth Summit at Johannesburg, 2002, RIO+20, UN Summit on Millennium Development Goals, 2000, Copenhagen Summit, 2009. IPCC, UNEP, IGBP.

Unit-IX: Statistical Approaches and Modelling in Environmental Sciences

Attributes and Variables: types of variables, scales of measurement, measurement of Central tendency and Dispersion, Standard error, Moments – measure of Skewness and Kurtosis, Basic concept of probability theory, Sampling theory, Distributions - Normal, log-normal, Binomial, Poisson, t, χ^2 and F-distribution. Correlation, Regression, tests of hypothesis (t-test, χ^2-test ANOVA: one-way and two-way); significance and confidence limits.

Approaches to development of environmental models; linear, simple and multiple regression models, validation and forecasting. Models of population growth and interactions: Lotka-Voltera model, Leslie's matrix model.

Unit-X: Contemporary Environmental Issues

Global Environmental Issues – Biodiversity loss, Climate change, Ozone layer depletion. Sea level rise. International efforts for environmental protection.

National Action Plan on Climate Change (Eight National missions – National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining the Himalayan Ecosystem, National Mission for a

‘Green India’, National Mission for Sustainable Agriculture, National Mission on Strategic Knowledge for Climate Change).

Current Environmental Issues in India: Environmental issues related to water resource projects - Narmada dam, Tehri dam, Almatti dam, Cauvery and Mahanadi, Hydro-power projects in Jammu & Kashmir, Himachal and North-Eastern States.

Water conservation-development of watersheds, Rain water harvesting and ground water recharge.

National river conservation plan – Namami Gange and Yamuna Action Plan.

Eutrophication and restoration of lakes. Conservation of wetlands, Ramsar sites in India.

Soil erosion, reclamation of degraded land, desertification and its control.

Climate change - adaptability, energy security, food security and sustainability.

Forest Conservation – Chipko movement, Appiko movement, Silent Valley movement and Gandhamardhan movement. People Biodiversity register.

Wild life conservation projects: Project tiger, Project Elephant, Crocodile Conservation, GOI-UNDP Sea Turtle project, Indo-Rhino vision.

Carbon sequestration and carbon credits.

Waste Management – Swachha Bharat Abhiyan.

Sustainable Habitat: Green Building, GRIHA Rating Norms.

Vehicular emission norms in India.

Epidemiological Issues: Fluorosis, Arsenocosis, Goitre, Dengue.

Environmental Disasters: Minnamata Disaster, Love Canal Disaster, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukusima Daiichi nuclear disaster, 2011.

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship

EARTH, ATMOSPHERIC, OCEAN AND PLANETARY SCIENCES

PAPER I (PART B)

1. The Earth and the Solar System:
Milky Way and the solar system. Modern theories on the origin of the Earth and other planetary bodies. Earth‟s orbital parameters, Kepler‟s laws of planetary motion, Geological Time Scale; Space and time scales of processes in the solid Earth, atmosphere and oceans. Radioactive isotopes and their applications. Meteorites Chemical composition and the Primary differentiation of the earth. Basic principles of stratigraphy. Theories about the origin of life and the nature of fossil record. Earth‟s gravity and magnetic fields and its thermal structure: Concept of Geoid and, spheroid; Isostasy.

2. Earth Materials, Surface Features and Processes: Gross composition and physical properties of important minerals and rocks; properties and processes responsible for mineral concentrations; nature and distribution of rocks and minerals in different units of the earth and different parts of India. Physiography of the Earth; weathering, erosion, transportation and deposition of Earth‟s material; formation of soil, sediments and sedimentary rocks; energy balance of the Earth‟s surface processes; physiographic features and river basins in India

3. Interior of the Earth, Deformation and Tectonics
Basic concepts of seismology and internal structure of the Earth. Physico-chemical and seismic properties of Earth‟s interior. Concepts of stress and strain. Behaviour of rocks under stress; Folds, joints and faults. Earthquakes – their causes and measurement. Interplate and intraplate seismicity. Paleomagnetism, sea floor spreading and plate tectonics.

4. Oceans and Atmosphere
Hypsography of the continents and ocean floor –continental shelf, slope, rise and abyssal plains. Physical and chemical properties of sea water and their spatial variations. Residence times of elements in sea water. Ocean currents, waves and tides, important current systems, thermohaline circulation and the oceanic conveyor belt. Major water masses of the world‟s oceans. Biological productivity in the oceans.

Motion of fluids, waves in atmospheric and oceanic systems. Atmospheric turbulence and boundary layer. Structure and chemical composition of the atmosphere, lapse rate and stability, scale height, geopotential, greenhouse gases and global warming. Cloud formation and precipitation processes, air- sea interactions on different space and time scales. Insolation and heat budget, radiation balance, general circulation of the atmosphere and ocean. Climatic and sea level changes on different time scales. Coupled ocean-atmosphere system, El Nino Southern Oscillation (ENSO). General weather systems of India, - Monsoon system, cyclone and jet stream, Western disturbances and severe local convective systems, distribution of precipitation over India.

Marine and atmospheric pollution, ozone depletion.

5. Environmental Earth Sciences

Properties of water; hydrological cycle; water resources and management. Energy resources, uses, degradation, alternatives and management; Ecology and biodiversity. Impact of use of energy and land on the environment. Exploitation and conservation of mineral and other natural resources. Natural hazards. Elements of Remote Sensing.

PAPER I (PART C)

I. GEOLOGY

1) MINERALOGY AND PETROLOGY:

Concept of point group, space group, reciprocal lattice, diffraction and imaging. Concepts of crystal field theory and mineralogical spectroscopy. Lattice defects (point, line and planar). Electrical, magnetic and optical properties of minerals. Bonding and crystal structures of common oxides, sulphides, and silicates. Transformation of minerals – polymorphism, polytypism, and polysomatism. Solid solution and exsolution.

Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma-mixing, -mingling and -immiscibility.

Metamorphic structures and textures; isograds and facies. Mineral reactions with condensed phases, solid solutions, mixed volatile equilibria and thermobarometry. Metamorphism of pelites, mafic-ultra mafic rocks and siliceous dolomites. Material transport during metamorphism. P-T-t path in regional metamorphic terrains, plate tectonics and metamorphism.

Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, alkaline rocks, Kimberlites, ophiolites and granitoids.

2) STRUCTURAL GEOLOGY AND GEOTECTONICS:

Theory of stress and strain. Behaviour of rocks under stress. Mohr circle. Various states of stress and their representation by Mohr circles. Different types of failure and sliding criteria. Geometry and mechanics of fracturing and conditions for reactivation of pre-existing discontinuities. Common types of finite strain ellipsoids. L-, L-S-, and S-tectonic fabrics. Techniques of strain analysis. Particle paths and flow patterns. Progressive strain history. Introduction to deformation mechanisms. Role of fluids in deformation processes. Geometry and analyses of brittle-ductile and ductile shear zones. Sheath folds. Geometry and mechanics of development of folds, boudins, foliations and lineations. Interference patterns of superposed fold. Fault-related folding. Gravity induced structures. Tectonic features of extensional-, compressional-, and strike-slip-terrains and relevance to plate boundaries. mantle plumes.

Himalayan Orogeny; concept of super continent, their assembly and breakup.

3) PALEONTOLOGY AND ITS APPLICATIONS:

Theories on origin of life. Organic evolution – Punctuated Equilibrium and Phyletic Gradualism models. Mass extinctions and their causes. Application of fossils in age determination and correlation. Paleoecology, Life habitats and various ecosystems, Paleobiogeography. Modes of preservation of fossils and taphonomic considerations. Types of microfossils. Environmental significance of fossils and trace fossils. Use of microfossils in interpretation of sea floor tectonism. Application of micropaleontology in hydrocarbon exploration. Oxygen and Carbon isotope studies of microfossils and their use in paleoceanographic and paleoclimatic interpretation. Important invertebrate fossils, vertebrate fossils, plant fossils and microfossils in Indian stratigraphy.

4) SEDIMENTOLOGY AND STRATIGRAPHY:

Classification of sediments and sedimentary rocks ; elastic, volcanoclastic and chemical. Classification of elastic rocks. Flow regimes and processes of sediment transport. Sedimentary textures and structures. Sedimentary facies and environments, reconstruction of paleoenvironments. Formation and evolution of sedimentary basins. Diagenesis of siliciclastic and carbonate rocks.

Recent developments in stratigraphic classification. Code of stratigraphic nomenclature – Stratotypes, Global Boundary Stratotype Sections and Points (GSSP). Lithostratigraphic, chronostratigraphic and biostratigraphic subdivisions. Methods of startigraphic correlation including Shaw‟s Graphic correlation. Concept of sequence stratigraphy. Rates of sediment accumulation, unconformities. Facies concept in Stratigraphy – Walther‟s law. Methods for paleogeographic reconstruction. Earth‟s Climatic History. Phanerozoic stratigraphy of India with reference to the type areas– their correlation with equivalent formations in other regions. Boundary problems in Indian Phanerozoic stratigraphy.

5) MARINE GEOLOGY AND PALEOCEANOGRAPHY:

Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. hydrothermal vents-. Ocean margins and their significance. Ocean Circulation, Coriolis effect and Ekman spiral, convergence, divergence and upwelling, El Nino. Indian Ocean Dipole Thermohaline circulation and oceanic conveyor belt. Formation of Bottom waters; major water masses of the world‟s oceans. Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; geochronology of oceanic sediments, diagenetic changes in oxic and anoxic environments. Tectonic evolution of the ocean basins. Mineral resources. Paleoceanography – Approaches to paleoceanographic reconstructions; various proxy indicators for paleoceanographic interpretation. Reconstruction of monsoon variability by using marine proxy records Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.

Methods of paleo Sea Surface temperature. Quantifications.

6) GEOCHEMISTRY:

Atomic Structure and properties of elements, the Periodic Table; ionic substitution in minerals; Phase rule and its applications in petrology, thermodynamics of reactions involving pure phases, ideal and non-ideal solutions, and fluids; equilibrium and distribution coefficients. Nucleation and

diffusion processes in igneous, metamorphic and sedimentary environments, redox reactions and Eh-pH diagrams and their applications. Mineral/mineral assemblages as „sensors" of ambient environments. Geochemical studies of aerosols, surface-, marine-, and ground waters. Radioactive decay schemes and their application to geochronology and petrogenesis. Stable isotopes and their application to earth system processes; geochemical differentiation of the earth; geochemical cycles.

7) ECONOMIC GEOLOGY:

Magmatic, hydrothermal and surface processes of ore formation. Metallogeny and its relation to crustal evolution; Active ore-forming systems, methods of mineral deposit studies including ore microscopy, fluid inclusions and isotopic systematics; ores and metamorphism- cause and effect relationships. Geological setting, characteristics, and genesis of ferrous, base and noble metals. Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps. Methods of petroleum exploration. Concepts of petrophysics, Petroliferous basins of India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resources of India. Gas hydrates and coal bed methane. Nuclear and non-conventional energy resources.

8) PRECAMBRIAN GEOLOGY AND CRUSTAL EVOLUTION:

Evolution of lithosphere, hydrosphere, atmosphere, biosphere, and cryosphere;, lithological, geochemical and stratigraphic characteristics of granite – greenstone and granulite belts. Stratigraphy and geochronology of the cratonic nuclei, mobile belts and Proterozoic sedimentary basins of India. Life in Precambrian. Precambrian – Cambrian boundary with special reference to India.

9) QUATERNARY GEOLOGY:

Definition of Quaternary. Quaternary Stratigraphy – Oxygen Isotope stratigraphy, biostratigraphy and magnetostratigraphy. Quaternary climates – glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, - land, ocean and cryosphere (ice core studies). Responses of geomorphic systems to climate, sea level and tectonics on variable time scales in the Quaternary, Quaternary dating methods, –radiocarbon, Uranium series, Luminescence, Amino-acid. Quaternary stratigraphy of India– continental records (fluvial, glacial, aeolian, palaeosols and duricrust); marine records; continental-marine correlation of Quaternary record.
Evolution of man and Stone Age cultures. Plant and animal life in relation to glacial and interglacial cycles during Quaternary.

Tectonic geomorphology, neotectonics, active tectonics and their applications to natural hazard assessment.

10) (I)APPLIED GEOLOGY:

(i) Remote Sensing and GIS: Elements of photogrammetry, elements of photo-interpretation, electromagnetic spectrum, emission range, film and imagery, sensors, geological interpretations of air photos and imageries. Global positioning systems. GIS- data structure, attribute data, thematic layers and query analysis.

(ii) Engineering Geology: Engineering properties of rocks and physical characteristics of building stones, concretes and other aggregates. Geological investigations for construction of dams, bridges, highways and tunnels. Remedial measures. Mass movements with special emphasis on landslides and causes of hillslope instability. Seismic design of buildings.

(iii) Mineral Exploration: Geological, geophysical, geochemical and geobotanical methods of surface and sub-surface exploration on different scales. Sampling, assaying and evaluation of mineral deposits.

(iv) Hydrogeology: Groundwater, Darcy‟s law, hydrological characteristics of aquifers, hydrological cycle. Precipitation, evapotranspiration and infiltration processes. Hydrological classification of water-bearing formations. Fresh and salt-water relationships in coastal and inland areas. Groundwater exploration and water pollution. Groundwater regimes in India.

(II) PHYSICAL GEOGRAPHY

1) Geomorphology: Concepts in geomorphology. Historical and process Geomorphology. Landforms in relation to climate, rock type, structure and tectonics. Processes – weathering, pedogenesis, mass movement, erosion, transportation and deposition. Geomorphic processes and landforms – fluvial, glacial, eolian, coastal and karst. River forms and processes – stream flow, stage-discharge relationship; hydrographs and flood frequency analysis. Submarine relief. Geomorphology and topographic analysis including DEM, Environmental change– causes, effects on processes and landforms. Extra-terrestrial geomorphology.

2) Climatology: Fundamental principles of climatology. Earth‟s radiation balance; latitudinal and seasonal variation of insolation, temperature, pressure, wind belts, humidity, cloud formation and precipitation, water balance. Air masses, monsoon, Jet streams, tropical cyclones, and ENSO. Classification of climates – Koppen‟s and Thornthwaite‟s scheme of classification. Climate change.

3) Bio-geography: Elements of biogeography with special reference to India; environment, habitat, plant-animal association; zoo-geography of India; Biomes, elements of plant geography, distribution of forests and major plant communities. Distribution of major animal communities. Conservation of forests. Wildlife sanctuaries and parks.

4) Environmental Geography: Man-land relationship. Resources – renewable and non-renewable. Natural and man-made hazards – droughts, floods, cyclones, earthquakes, landslides, tsunamis. Ecological balance, environmental pollution and deterioration.

5) Geography of India: Physiography, drainage, climate, soils and natural resources – the Himalaya, Ganga-Brahmaputra Plains, and peninsular India Precambrian shield, the Gondwana rift basins, Deccan Plateau. Indian climatology with special reference to seasonal distribution and variation of temperature, humidity, wind and precipitation; Climate zones of India. Agricultural geography of India. Population – its distribution and characteristics. Urbanization and migration. Environmental problems and issues.

(III) GEOPHYSICS

1) Signal Processing: Continuous and discrete signals; Fourier series; auto and cross correlations, linear time invariant systems with deterministic and random inputs; band limited signal and sampling theorem; Fourier and Fast Fourier transforms; Z-transform; convolution; Filters: discrete and continuous, recursive, non-recursive, optimal and inverse filters; deconvolution; fractal analysis.

2) Field theory: Newtonian potential; Laplace and Poisson‟s equations; Green‟s Theorem; Gauss‟ law; Continuation integral; equivalent stratum; Maxwell‟s equations and electromagnetic theory; Displacement potential, Helmhotz‟s theorem and seismic wave propagation.

3) Numerical analysis and inversion: Numerical differentiation and integration, finite element, and finite difference techniques; Simpson‟s rules; Gauss‟ quadrature formula; initial value problems; pattern recognition in Geophysics. Well posed and ill-posed problems; method of least squares; direct search and gradient methods; generalized inversion techniques; singular value decomposition; global optimization.

4) Gravity and Magnetic fields of the earth: Normal gravity field; Clairaut‟s theorem; Shape of the earth; deflection of the vertical, geoid, free-air, Bouguer and isostatic anomalies, isostatic models for local and regional compensation. Geomagnetic field, secular and transient variations and their theories; palaeomagnetism, construction of polar wandering curves.

5) Plate Tectonics and Geodynamics: Marine magnetic anomalies, sea floor spreading; mid-oceanic ridges and geodynamics; plate tectonics hypothesis; plate boundaries and seismicity. Heat flow mechanisms, thermal moddling of earth,core-mantle convection and mantle plumes.

6)Seismology Elastic theory: Seismometry: short period, long period, broad band and strong motion; elements of earthquake seismology; seismic sources: faulting source, double couple hypothesis, seismic moment tensor, focal mechanism and fault plane solutions; seismic gaps; seismotectonics and structure of the earth; Himalayan and stable continental region earthquakes, reservoir induced seismicity; seismic hazards; earthquake prediction, travel time residuals, velocity anomalies, seismic tomography.

7) Gravity and Magnetic Methods: Gravimeters and magnetometers; data acquisition from land, air and ship; corrections and reduction of anomalies; ambiguity; regional and residual separation; continuation and derivative calculations; interpretation of anomalies of simple geometric bodies, single pole, sphere, horizontal cylinder, sheet, dyke and fault. Forward modelling and inversion of arbitrary shaped bodies and 2-D, 3-D interfaces. Interpretations in frequency domain.

8) Electrical and Electromagnetic Methods: Electrical profiling and sounding, typical sounding curves, pseudo-sections; resistivity transform and direct interpretation; induced polarization methods. Electromagnetic field techniques; elliptic polarization, in-phase and out of phase components, horizontal and vertical loop methods; interpretation; VLF (very low frequency); AFMAG (Audio frequency magnetic) methods; and central frequency sounding; transient electromagnetic methods; magneto-telluric method; geomagnetic depth sounding.

9) Seismic Methods: Generalized Snell‟s Law; Ray theory; reflection, refraction, diffraction; Zoeppritz‟s equation; seismic energy sources; detectors; seismic noises and noise profile analysis; seismic data recording, reduction to a datum and weathering corrections; Interpretation of refraction

and reflection data; CDP/CMP; velocity analysis, F-K filtering, stacking, deconvolution, migration before and after stack; bright spot analysis; wavelet processing; attenuation studies, shear waves, AVO; VSP; introduction to 3D seismics; seismic stratigraphy.

10) Well logging: Open hole, cased hole and production logging; Electrical logs; lateral, latero, induction, temperature, S.P; porosity logs; sonic, density, neutron; natural gamma; determination of formation factor, porosity, permeability, density, water saturation, lithology; logging while drilling.

(IV) METEOROLOGY

1) Climatology: Same as under Geography

2) Physical Meteorology: Thermal structure of the atmosphere and its composition. Radiation: basic Laws - Rayleigh and Mie scattering, multiple scattering, radiation from the sun, solar constant, effect of clouds, surface and planetary albedo. Emission and absorption of terrestrial radiation, radiation windows, radiative transfer, Greenhouse effect, net radiation budget; Thermodynamics of dry and moist air: specific gas constant, Adiabatic and isoentropic processes, entropy and enthalpy, Moisture variables, virtual temperature; Clausius – Clapeyron equation, adiabatic process of moist air; thermodynamic diagrams: Hydrostatic equilibrium: Hydrostatic equation, variation of pressure with height, geopotential, standard atmosphere, altimetry. Vertical stability of the atmosphere: Dry and moist air parcel and slice methods. Tropical convection. Atmospheric optics - visibility - optical phenomenon - rainbows, haloes, corona, glarg, mirage.

3) Atmospheric Electricity: Fair weather electric field in the atmosphere and potential gradients, ionization in the atmosphere. Electrical fields in thunderstorms, theories of thunderstorm electrification - Structure of lightening flash-mechanism of earth-atmospheric change balance-role of thunderstroms.

4) Cloud Physics: Cloud classification, condensation nuclei, growth of cloud drops and ice-crystals, precipitation mechanisms: Bergeron, Findeisen process, coalescence process – Precipitation of warm and mixed clouds, artificial precipitation, hail suppression, fog and cloud – dissipation, radar observation of clouds and precipitation, radar equation, rain drop spectra, radar echoes of hail storm and tornadoes, radar observation of hurricanes, measurements of rainfall by radar.

5) Dynamic Meteorology: Basic equations and fundamental forces: Pressure, gravity, centripetal and Corolis forces, continuity equation in Cartesian and isobaric coordinates. Momentum equation Cartesian and spherical coordinates; scale analysis, inertial flow, geostrophic and gradient winds, thermal wind. Divergence and vertical motion Rossby, Richardson, Reynolds and Froude numbers. Circulation, vorticity and divergence; Bjerknese circulation theorem and applications, vorticity and divergence equations, scale analysis, potential vorticity, stream function and velocity potential. Atmospheric turbulence: Mixing length theory, planetary boundary layer equations, surface layer, Ekman layer, eddy transport of heat, moisture and momentum, Richardson criterion; Linear Perturbation Theory: Internal and external gravity waves, inertia waves, gravity waves, Rossby waves, wave motion in the tropics, barotropic and baroclinic instabilities. Atmospheric Energetics: Kinetic, potential and internal energies – conversion of potential and internal energies into kinetic energy, available potential energy.

6) Numerical Weather Prediction: computational instability, filtering of sound and gravity waves, filtered forecast equations, barotropic and equivalent barotropic models, two parameter baroclinic model, relaxation method. Multi-layer primitive equation models. Short, medium and long range weather prediction. Objective analysis; Initialization of the data for use in weather prediction models; data assimilation techniques, application of satellite in NWP (Numerical Weather Prediction) and remotely sensed data.

7) General Circulation and Climate Modelling: Observed zonally symmetric circulations, meridional circulation models, mean meridional and eddy transport of momentum and energy, angular momentum and energy budgets; zonally asymmetric features of general circulation; standing eddies; east-west circulations in tropics: climate variability and forcings; feedback processes, low frequency variability, MJO Madden-Julian oscillation), ENSO, QBO (quasi-biennial oscillation) and sunspot cycles. Basic principles of general circulation modelling; grid-point and spectral GCMs; role of the ocean in climate modelling; interannual variability of ocean fields (SST, winds, circulation, etc.) and its relationship with monsoon, concepts of ocean – atmosphere coupled models.

8) Synoptic Meteorology: Weather observations and transmission, synoptic charts, analysis of surface, upper air another derivative chart, stream-lines, isotachs and contour analysis; tilt and slope of pressure/weather systems with height. Synoptic weather forecasting, prediction of weather elements such as rain, maximum and minimum temperature and fog; hazardous weather elements like thunderstorms, duststorms, tornadoes. Tropical meteorology: Trade wind inversion, ITCZ; monsoon trough tropical cyclones, their structure and development theory; monsoon depressions; tropical easterly jet stream; low level jets, Somali jet, waves in easterlies; western disturbances; SW and NE monsoons; synoptic features associated with onset, withdrawal, break active and weak monsoons and their prediction. Air masses and fronts: sources, origin and classification of air masses; and fronts, frontogenesis and frontolysis; structure of cold and warm fronts; weather systems associated with fronts. Extra-tropical synoptic scale features: jet streams, extratropical cyclones and anticyclones.

9) Aviation Meteorology: Role of meteorology in aviation, weather hazards associated with take off cruising and landing, inflight – icing, turbulence, visibility, fog, clouds, rain, gusts, wind shear and thunderstorms, nowcasting and very short range forecasting.

10) Satellite Meteorology: Meteorological satellites – Polar orbiting and geostationary satellites, visible and infrared radiometers, multiscanner radiometers; identification of synoptic systems, fog and sandstorms, detection of cyclones, estimation of SST, cloud top temperatures, winds and rainfall: temperature and humidity soundings.

(V) OCEAN SCIENCES

1) Physical Oceanography: T-S diagrams; mixing processes in the oceans; characteristics of important water masses.
Wind generated waves in the oceans; their characteristics; shallow and deep water waves. Propagation, refraction, and reflection of waves. Wave spectrum, principles of wave forecasting.

Tide-producing forces and their magnitudes; prediction of tides by the harmonic method; tides and tidal currents in shallow seas, estuaries and rivers. Factors influencing coastal processes; transformation of waves in shallow water; effects of stratification; effect of bottom friction,

phenomena of wave reflection, refraction and diffraction; breakers and surf; littoral currents; wave action on sediments – movement to beach material; rip currents; beach stability, ocean beach nourishment; harbour resonance; seiches; tsunami; interaction of waves and structure.
Estuaries: classification and nomenclature; tides in estuaries; estuarine circulation and mixing; depth – averaged and breadth – averaged models; sedimentation in estuaries; salinity intrusion in estuaries; effect of stratification; coastal pollution; mixing and dispersal of pollutants in estuaries and near-shore areas; coastal zone management.
The global wind system; action of wind on ocean surface; Ekman‟s theory; Sverdrup, Stommel and Munk‟s theories; upwelling and sinking with special reference to the Indian ocean. Inertial currents; divergences and convergences; geostrophic motion; barotropic and baroclinic conditions; oceanic eddies, relationship between density, pressure and dynamic topography; relative and slope currents. Wind driven coastal currents; typical scales of motion in the ocean.
Characteristics of the global conveyor belt circulation and its causes.
Formation of subtropical gyres; western boundary currents; equatorial current systems; El Nino; monsoonal winds and currents over the North Indian Ocean; Somali current; southern ocean. Upwelling process in the Arabian Sea.

2) Chemical Oceanography: Composition of seawater – Classification of elements based on their distribution; major and minor elements, their behavior and chemical exchanges across interfaces and residence times in seawater.

Element chemistry in atypical conditions-estuaries, hydrothermal vents, anoxic basins, HNLC waters, sediment pore fluid and anthropogenic inputs.

Chemical and biological interactions – Ionic interactions; biochemical cycling of nutrients, trace metals and organic matter. Air-sea exchange of important biogenic dissolved gases; carbon dioxide-carbonate system; alkalinity and control of pH; biological pump.

Factors affecting sedimentary deposits-$CaCO_3$, Silicate, Manganese nodules, phosphorites and massive single deposits.

3) Geological Oceanography: Same topics as under subhead “Marine Geology & paleo-oc e anogra ph
y”

4) Biological Oceanography: Classification of the marine environment and marine organisms.

Physio-chemical factors affecting marine life – light, temperature, salinity, pressure, nutrients, dissolved gases; adaptation and biological processes.

Primary and secondary production; factors controlling phytoplankton and zooplankton abundance and diversity; nekton and fisheries oceanography; benthic organisms; coastal marine communities and community ecology – estuaries, coral reefs and mangrove communities, deep-sea ecology including hydrothermal vent communities.

Energy flow and mineral cycling – energy transfer and transfer efficiencies through different trophic levels; food webs including the microbial loop.

Human impacts on marine communities; impacts of climate change on marine biodiversity.
Impact of pollution on marine environments including fisheries.

UNIVERSITY GRANTS COMMISSION
NET BUREAU

NET SYLLABUS

Subject: Library and Information Science **Code No. : 59**

Unit – I

1. Data, Information, Knowledge and Wisdom.
2. Information Life Cycle - Generation, Collection, Storage and Dissemination.
3. Role of Information in Planning, Management, Socio-economic, Cultural, Educational and Technological Development.
4. Information Science - Relationship with other subjects, Information Society and Knowledge Society.
5. Communication – Concept, Types, Theories, Models, Channels and Barriers; Trends in Scholarly Communication.
6. Information Industry - Generators, Providers and Intermediaries.
7. IPR and Legal Issues - Categories, Conventions, Treaties, Laws.
8. Plagiarism: Concept and Types.
9. Right to Information Act (RTI); Information Technology Act.
10. National Knowledge Commission; National Mission on Libraries.

Unit – II

1. Historical Development of Libraries in India; Committees and Commissions on Libraries in India.
2. Types of Libraries – Academic, Public, Special and National.
3. Library Legislation and Library Acts in Indian States; The Press and Registration of Books Act; The Delivery of Books and Newspapers (Public Libraries) Act.
4. Laws of Library Science.
5. Library and Information Science Profession - Librarianship as a Profession, Professional Skills and Competences; Professional Ethics.
6. Professional Associations - National – ILA, IASLIC, IATLIS; International – IFLA, ALA, CILIP, ASLIB, SLA; Role of UGC, RRRLF and UNESCO in Promotion and Development of Libraries.
7. Library and Information Science Education in India.
8. Library Public Relations and Extension Activities.
9. Type of Users - User Studies, User Education.

10. Information Literacy - Areas, Standards, Types and Models; Trends in Information Literacy.

Unit – III

1. Information Sources - Nature, Characteristics, Types and Formats.
2. Sources of Information - Primary, Secondary and Tertiary; Documentary and Non-Documentary.
3. Primary Information Sources (Print and Electronic) - Journals, Conference Proceedings, Patents, Standards, Theses & Dissertations, Trade Literature.
4. Secondary Information Sources (Print and Electronic) - Dictionaries, Encyclopedias, Bibliographies, Indexing & Abstracting, Statistical sources, Handbooks and Manuals.
5. Tertiary Information Sources (Print and Electronic)- Directories, Year Books, Almanacs.
6. Reference Sources - Bibliographical, Biographical, Educational, Language and Geographical.
7. Electronic Information Resources - Subject Gateways, Web Portals, Bulletin Boards, Discussion Forums /Groups.
8. Databases: Bibliographic, Numeric, Full text, Multimedia; Open Access Databases.
9. Institutional and Human Resources.
10. Evaluation of Reference Sources and Web Resources.

Unit - IV

1. Community Information Services.
2. Reference Service – Concept and Types; Referral Services
3. Alerting Services - CAS, SDI, Inter Library Loan and Document Delivery.
4. Mobile based Library Services and Tools – Mobile OPAC, Mobile Databases, Mobile Library Website, Library Apps, Mobile Library Instructions, Augmented Reality, SMS Alerts, Geo-Location, Reference Enquiry.
5. Web 2.0 and 3.0 - Library 2.0- Concept, Characteristics, Components; Instant Messaging, RSS Feeds, Podcasts, Vodcasts, Ask a Librarian
6. Collaborative Services- Social Networks, Academics Social Networks, Social Tagging, Social Bookmarking.
7. Web – Scale Discovery Services
8. National Information Systems and Networks: NISCAIR, DESIDOC, SENDOC, ENVIS, INFLIBNET, DELNET, NICNET, ERNET, National Knowledge Network (NKN), Biotechnology Information System Network
9. International Information Systems and Networks: INIS, AGRIS, INSPEC, MEDLARS, BIOSIS, ERIC, Patent Information System (PIS), Biotechnology Information System (BIS).
10. Library Resource Sharing and Library Consortia – National and International.

Unit - V

1. Universe of Knowledge - Nature and Attributes; Modes of Formation of Subjects.
2. Knowledge Organisation - Classification – Theories, Cannons, and Principles; Simple Knowledge Organisation System (SKOS), Taxonomies, Folksonomy, Trends in Classification.
3. Mapping of Subjects in Library Classification Schemes – DDC, UDC and CC.
4. Knowledge Organisation: Cataloguing - Cannons and Principles; Centralized and Co-operative Catalogue; Library Cataloguing Codes: CCC and AACR - II.
5. Standards of Bibliographic Record Formats and Description – ISBD, MARC 21, CCF, RDA, FRBR, Bibframe.
6. Standards for Bibliographic Information Interchange & Communication – ISO 2709, Z39.50, Z39.71.
7. Metadata Standards: Dublin Core; MARC21, METS, MODES, EAD.
8. Indexing Systems and Techniques: Assigned - Pre-coordinate; Post-Coordinate; Derived- Title-based; Vocabulary Control.
9. Abstracting – Types and Guidelines.
10. Information Retrieval System – Features, Components, Models and Evaluation.

Unit - VI

1. Management - Principles, Functions and Schools of thought.
2. Library and Information Centers Management - Book Selection Tools and Principles; Library Acquisition, Technical Processing, Circulation, Serial Control, Maintenance and Stock Verification; Preservation and Conservation; Hazards and Control Measures of Library Materials.
3. Human Resource Management – Planning, Job Analysis, Job Description, Job Evaluation, Selection, Recruitment, Motivation, Training and Development, Performance Appraisal; Staff Manual.
4. Financial Management in Libraries - Sources of Finance, Resource Mobilisation, Budgeting Methods; Cost Effective and Cost Benefit Analysis, Annual Reports & Statistics; Library Authority and Committee.
5. Project Management - SWOT, PEST, PERT / CPM.
6. Total Quality Management (TQM) - Concepts, Principles and Techniques, Six Sigma; Evaluation of Services of Libraries and Information Centers.
7. Library Building, Furniture and Equipments; Green Library Building; Information Commons; Makers Space; Security and Safety.
8. Management Information System (MIS), MBO, Change Management, Disaster Management, Crisis Management.
9. Knowledge Management – Principles, Tools, Components and Architecture.
10. Marketing of Library Products and Services – Plan, Research, Strategies, Mix, Segmentation, Pricing and Advertising; Management Consultancy.

Unit - VII

1. Computer Technology - Character Representation (ASCII, ISCII, Unicode); Computer Hardware, Software; Storage Devices; Input and Output Devices.
2. Types of Software - System Software, Application Software.
3. Programming Languages – Object Oriented, Procedural, High Level, Scripting; Web Languages.
4. Telecommunication - Transmission Channels, Mode, and Media, ISDN, PSDN, Multiplexing, Modulation, Standards and Protocols.
5. Wireless Communication – Media, Wi-fi, Li-fi, Satellite Communication, Mobile Communication.
6. Computer Networks - Topologies, Types of Networks – LAN, MAN, WAN.
7. Internet - Web browsers, WWW, E-mail; Search Engines, Meta and Entity Search engines.
8. Internet Protocols and Standards – HTTP, SHTTP, FTP, SMTP, TCP/IP, URI, URL.
9. Hypertext, Hypermedia, Multimedia, Video conferencing, Virtual Reality, Augmented Technologies.
10. Data Security, Network Security, Firewalls, Cryptographic Techniques, Anti-virus software, Anti-spyware, Intrusion Detection System.

Unit – VIII

1. Library Automation – Areas, Planning, Selection of Hardware and Software, Implementation and Evaluation; Standards for Library Automation.
2. Barcode, RFID, QR Code, Biometric, Smartcard: Features and Applications.
3. Digitization – Planning, Selection of Materials, Hardware, Software, Process, Issues.
4. Digital Library: Genesis, Characteristics, Types, Architecture; Standards, Formats and Protocols, DOI.
5. Digital Preservation - Need, Purpose, Standards, Methods, Techniques, Projects (National and International).
6. Digital Library Initiatives – National and International.
7. Institutional Repositories - Need, Purpose, Types and Tools; Institutional Repositories in India; ROAR, DOAR, SHARPA-ROMIO.
8. Content Management Systems – Architecture, Data Integration, CMS Software – Selection, Implementation and Evaluation.
9. Application of Artificial Intelligence, Expert Systems and Robotics in Libraries; Social Mobile Analytics Cloud (SMAC); Cloud Computing.
10. Ontology – Tools (RDF, RDFS, Potege); Semantic Web, Linked Data, Big Data, Data Mining, Data Harvesting.

Unit – IX

1. Research - Concept, Purpose, Functions, Scope and Ethics; Types of Research – Basic and Applied, Interdisciplinary and Multidisciplinary.
2. Research Methods: Historical, Descriptive, Experimental and Delphi.
3. Research Design - Selection of Research Problem, Review of Literature; Formulation of Research Problem; Hypothesis – Formulation, Types and Testing; Sampling Techniques.
4. Methods of Data Collection: Questionnaire, Interview, Observation, Library Records, Scales and Checklist.
5. Data Analysis and Interpretation - Presentation of Data; Statistical Methods/ Techniques.
6. Statistical Packages – Spreadsheet, SPSS, Bibexcel, 'R' Statistics.
7. Research Report Writing and Citation Tools – Structure, Style, Contents, Guidelines; Style Manuals; Online Citation Tools; Reference Style Management Tools; Anti-plagiarism Tools; Evaluation of Research Report.
8. Metric Studies in LIS - Bibliometrics, Scientometric, Webometrics, Altmetrics;
9. Impact Factors – Journal, Institutional and Authors; h-Index, g-Index, i10 Index.
10. Trends in Library and Information Science Research.

Unit –X

1. Academic Library and Information System.
2. Public Library and Information System.
3. Special Library and Information System.
4. Health Science Library and Information System.
5. Corporate Library and Information System.
6. Agricultural Library and Information System.
7. Engineering and Technological Library and Information System.
8. Archive, Museums and Oriental Libraries.
9. Community Information System.
10. Information Services and System for Persons with Disability, Children and Women.

CSIR-UGC National Eligibility Test (NET) for Junior Research Fellowship and Lecturer-ship
COMMON SYLLABUS FOR PART 'B' AND 'C'
MATHEMATICAL SCIENCES
UNIT – 1

Analysis: Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum.

Sequences and series, convergence, limsup, liminf.

Bolzano Weierstrass theorem, Heine Borel theorem.

Continuity, uniform continuity, differentiability, mean value theorem.

Sequences and series of functions, uniform convergence.

Riemann sums and Riemann integral, Improper Integrals.

Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral.

Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems.

Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations.

Algebra of matrices, rank and determinant of matrices, linear equations.

Eigenvalues and eigenvectors, Cayley-Hamilton theorem.

Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.

Inner product spaces, orthonormal basis.

Quadratic forms, reduction and classification of quadratic forms

UNIT – 2

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions.
Analytic functions, Cauchy-Riemann equations.

Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem.

Taylor series, Laurent series, calculus of residues.

Conformal mappings, Mobius transformations.

Algebra: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle, derangements.

Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots.

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems.

Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain.

Polynomial rings and irreducibility criteria.

Fields, finite fields, field extensions, Galois Theory.

Topology: basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT – 3

Ordinary Differential Equations (ODEs):

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs.

General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs):

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs.

Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis :

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and

Runge-Kutta methods.

Calculus of Variations:

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations:

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Classical Mechanics:

Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, Two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.

UNIT – 4

Descriptive statistics, exploratory data analysis

Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions (univariate and multivariate); expectation and moments. Independent random variables, marginal and conditional distributions. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case).
Markov chains with finite and countable state space, classification of states, limiting behaviour of n-step transition probabilities, stationary distribution, Poisson and birth-and-death processes.

Standard discrete and continuous univariate distributions. sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range.

Methods of estimation, properties of estimators, confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests.

Simple nonparametric tests for one and two sample problems, rank correlation and test for independence. Elementary Bayesian inference.

Gauss-Markov models, estimability of parameters, best linear unbiased estimators, confidence intervals, tests for linear hypotheses. Analysis of variance and covariance. Fixed, random and mixed effects models. Simple and multiple linear regression. Elementary regression diagnostics. Logistic regression.

Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.

Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.

Completely randomized designs, randomized block designs and Latin-square designs. Connectedness and orthogonality of block designs, BIBD. 2^{κ} factorial experiments: confounding and construction.

Hazard function and failure rates, censoring and life testing, series and parallel systems.

Linear programming problem, simplex methods, duality. Elementary queuing and inventory models. Steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1.

All students are expected to answer questions from Unit I. Students in mathematics are expected to answer additional question from Unit II and III. Students with in statistics are expected to answer additional question from Unit IV.

UNIVERSITY GRANTS COMMISSION
NET BUREAU

NET SYLLABUS

Subject : GEOGRAPHY Code No.:(80)

Unit I - Geomorphology

Unit II - Climatology

Unit III- Oceanography

Unit IV- Geography of Environment

Unit V - Population and Settlement Geography

Unit VI- Geography of Economic Activities and Regional Development

Unit VII - Cultural, Social and Political Geography

Unit VIII - Geographic Thought

Unit IX - Geographical Techniques

Unit X- Geography of India

UNIT-I

Geomorphology

Continental Drift, Plate Tectonics, Endogenetic and Exogenetic forces. Denudation and Weathering, Geomorphic Cycle (Davis and Penck), Theories and Process of Slope Development, Earth Movements (seismicity, folding, faulting and vulcanicity), Landform Occurrence and Causes of Geomorphic Hazards (earthquakes, volcanoes, landslides and avalanches)

UNIT –II

Climatology

Composition and Structure of Atmosphere; Insolation, Heat Budget of Earth, Temperature, Pressure and Winds, Atmospheric Circulation (air-masses, fronts and upper air circulation, cyclones and anticyclones (tropical and temperate), Climatic Classification of Koppen & Thornthwaite, ENSO Events (El Nino, La Nina and Southern Oscillations), Meteorological Hazards and Disasters (Cyclones, Thunderstorms, Tornadoes, Hailstorms, Heat and Cold waves Drought and Cloudburst , Glacial Lake Outburst (GLOF), Climate Change: Evidences and Causes of Climatic Change in the past, Human impact on Global Climate.

UNIT-III

Oceanography

Relief of Oceans, Composition: Temperature, Density and Salinity, Circulation: Warm and Cold Currents, Waves, Tides, Sea Level Changes, Hazards: Tsunami and Cyclone

UNIT –IV

Geography of Environment

Components: Ecosystem (Geographic Classification) and Human Ecology, Functions: Trophic Levels, Energy Flows, Cycles (geo-chemical, carbon, nitrogen and oxygen), Food Chain, Food Web and Ecological Pyramid, Human Interaction and Impacts, Environmental Ethics and Deep Ecology, Environmental Hazards and Disasters (Global Warming, Urban Heat Island, Atmospheric Pollution, Water Pollution, Land Degradation), National Programmes and Policies: Legal Framework, Environmental Policy, International Treaties, International Programmes and Polices (Brundtland Commission, Kyoto Protocol, Agenda 21, Sustainable Development Goals, Paris Agreement)

UNIT –V

Population and Settlement Geography

Population Geography

Sources of population data (census, sample surveys and vital statistics, data reliability and errors). World Population Distribution (measures, patterns and determinants), World Population Growth (prehistoric to modern period). Demographic Transition, Theories of Population Growth (Malthus, Sadler, and Ricardo). Fertility and Mortality Analysis (indices, determinants and world patterns). Migration (types, causes and consequences and models), Population Composition and Characteristics (age, sex, rural-urban, occupational structure and educational levels), Population Policies in Developed and Developing Countries.

Settlement Geography

Rural Settlements (types, patterns and distribution), Contemporary Problems of Rural Settlements (rural-urban migration; land use changes; land acquisition and transactions), Theories of Origin of Towns (Gordon Childe, Henri Pirenne, Lewis Mumford), Characteristics and Processes of Urbanization in Developed and Developing Countries (factors of urban growth, trends of urbanisation, size, structure and functions of urban areas). Urban Systems (the law of the primate city and rank size rule) Central Place Theories (Christaller and Losch), Internal Structure of the City, Models of Urban Land Use (Burgess, Harris and Ullman , and Hoyt), Concepts of Megacities, Global Cities and Edge Cities, Changing Urban Forms (peri-urban areas, rural-urban fringe, suburban , ring and satellite towns), Social Segregation in the City, Urban Social Area Analysis, Manifestation of Poverty in the City (slums, informal sector growth, crime and social exclusion).

Unit–VI:

Geography of Economic Activities and Regional Development

Economic Geography

Factors affecting spatial organisation of economic activities (primary, secondary, tertiary and quarternary), Natural Resources (classification, distribution and associated problems), Natural Resources Management. World Energy Crises in Developed and Developing Countries.

Agricultural Geography

Land capability classification and Land Use Planning, Cropping Pattern: Methods of delineating crop combination regions (Weaver, Doi and Rafiullah), Crop diversification, Von Thunen's Model of Land Use Planning. Measurement and Determinants of Agricultural Productivity, Regional variations in Agricultural Productivity, Agricultural Systems of the World.

Industrial Geography

Classification of Industries, Factors of Industrial Location; Theories of Industrial Location (A. Weber, E. M. Hoover, August Losch, A. Pred and D. M. Smith). World Industrial Regions, Impact of Globalisation on manufacturing sector in Less Developed Countries, Tourism Industry, World distribution and growth of Information And Communication Technology (ICT) and Knowledge Production (Education and R & D) Industries.

Geography of Transport and Trade

Theories and Models of spatial interaction (Edward Ullman and M. E. Hurst) Measures and Indices of connectivity and accessibility; Spatial Flow Models: Gravity Model and its variants, World Trade Organisation, Globalisation and Liberalisation and World Trade Patterns. Problems and Prospects of Inter and Intra Regional Cooperation and Trade.

Regional Development

Typology of Regions, Formal and Fictional Regions, World Regional Disparities, Theories of Regional Development(Albert O. Hirschman, Gunnar Myrdal, John Friedman, Dependency theory of Underdevelopment, Global Economic Blocks, Regional Development and Social Movements in India

Unit – VII: Cultural, Social and Political Geography

Cultural and Social Geography

Concept of Culture, Cultural Complexes, Areas and Region, Cultural Heritage, Cultural Ecology. Cultural Convergence, Social Structure and Processes, Social Well-being and Quality of Life, Social Exclusion, Spatial distribution of social groups in India (Tribe, Caste, Religion and Language), Environment and Human Health, Diseases Ecology, Nutritional Status (etiological conditions, classification and spatial and seasonal distributional patterns with special reference to India) Health Care Planning and Policies in India, Medical Tourism in India.

Political Geography

Boundaries and Frontiers (with special reference to India), Heartland and Rimland Theories. Trends and Developments in Political Geography, Geography of Federalism, Electoral Reforms in India, Determinants of Electoral Behaviour, Geopolitics of Climate Change, Geopolitics of World Resources, Geo-politics of India Ocean, Regional Organisations of Cooperation (SAARC, ASEAN, OPEC, EU). Neopolitics of World Natural Resources.

Unit VIII: Geographic Thought

Contributions of Greek, Roman, Arab, Chinese and Indian Scholars, Contributions of Geographers (Bernhardus Varenius, Immanuel Kant, Alexander von Humboldt, Carl Ritter, Scheafer & Hartshorne), Impact of Darwinian Theory on Geographical Thought. Contemporary trends in Indian Geography: Cartography, Thematic and Methodological contributions. Major Geographic Traditions (Earth Science, man-environment relationship, area studies and spatial analysis), Dualisms in Geographic Studies (physical vs. human, regional vs. systematic, qualitative vs. quantitative, ideographic vs. nomothetic), Paradigm Shift, Perspectives in Geography (Positivism, Behaviouralism, Humanism, Structuralism, Feminism and Postmodernism).

Unit IX: Geographical Techniques

Sources of Geographic Information and Data (spatial and non-spatial), Types of Maps, Techniques of Map Making (Choropleth, Isarithmic, Dasymetric, Chorochromatic, Flow Maps) Data Representation on Maps (Pie diagrams, Bar diagrams and Line Graph, GIS Database (raster and vector data formats and attribute data formats). Functions of GIS (conversion, editing and analysis), Digital Elevation Model (DEM), Georeferencing (coordinate system and map projections and Datum), GIS Applications (thematic cartography, spatial decision support system), Basics of Remote Sensing (Electromagnetic Spectrum, Sensors and Platforms, Resolution and Types, Elements of Air Photo and Satellite Image Interpretation and Photogrammetry), Types of Aerial Photographs, Digital Image Processing: Developments in Remote Sensing Technology and Big Data Sharing and its applications in Natural Resources Management in India, GPS Components (space, ground control and receiver segments) and Applications, Applications of Measures of Central Tendency, Dispersion and Inequalities, Sampling, Sampling Procedure and Hypothesis Testing (*chi* square test, *t* test, ANOVA), Time Series Analysis, Correlation and Regression Analysis, Measurement of Indices, Making

Indicators Scale Free, Computation of Composite Index, Principal Component Analysis and Cluster Analysis, Morphometric Analysis: Ordering of Streams, Bifurcation Ratio, Drainage Density and Drainage Frequency, Basin Circularity Ratio and Form Factor, Profiles, Slope Analysis, Clinographic Curve, Hypsographic Curve and Altimetric Frequency Graph.

Unit – X: Geography of India

Major Physiographic Regions and their Characteristics; Drainage System (Himalayan and Peninsular), Climate: Seasonal Weather Characteristics, Climatic Divisions, Indian Monsoon (mechanism and characteristics), Jet Streams and Himalayan Cryosphere, Types and Distribution of Natural Resources: Soil, Vegetation, Water, Mineral and Marine Resources. Population Characteristics (spatial patterns of distribution), Growth and Composition (rural-urban, age, sex, occupational, educational, ethnic and religious), Determinants of Population, Population Policies in India, Agriculture (Production, Productivity and Yield of Major Food Crops), Major Crop Regions, Regional Variations in Agricultural Development, Environmental, Technological and Institutional Factors affecting Indian Agriculture; Agro-Climatic Zones, Green Revolution, Food Security and Right to Food. Industrial Development since Independence, Industrial Regions and their characteristics, Industrial Policies in India. Development and Patterns of Transport Networks (railways, roadways, waterways, airways and pipelines), Internal and External Trade (trend, composition and directions), Regional Development Planning in India, Globalisation and its impact on Indian Economy, Natural Disasters in India (Earthquake, Drought, Flood, Cyclone, Tsunami, Himalayan Highland Hazards and Disasters.)

UNIVERSITY GRANTS COMMISSION

NET BUREAU

Subject: PSYCHOLOGY Code No. **04**

SYLLABUS

1. Emergence of Psychology

Psychological thought in some major Eastern Systems: Bhagavad Gita, Buddhism, Sufism and Integral Yoga. Academic psychology in India: Pre-independence era; post-independence era; 1970s: The move to addressing social issues; 1980s: Indigenization; 1990s: Paradigmatic concerns, disciplinary identity crisis; 2000s: Emergence of Indian psychology in academia. Issues: The colonial encounter; Post colonialism and psychology; Lack of distinct disciplinary identity.

Western: Greek heritage, medieval period and modern period. Structuralism, Functionalism, Psychoanalytical, Gestalt, Behaviorism, Humanistic-Existential, Transpersonal, Cognitive revolution, Multiculturalism. Four founding paths of academic psychology - Wundt, Freud, James, Dilthey. Issues: Crisis in psychology due to strict adherence to experimental-analytical paradigm (logical empiricism). Indic influences on modern psychology.

Essential aspects of knowledge paradigms: Ontology, epistemology, and methodology. Paradigms of Western Psychology: Positivism, Post-Positivism, Critical perspective, Social Constructionism, Existential Phenomenology, and Co-operative Enquiry. Paradigmatic Controversies. Significant Indian paradigms on psychological knowledge: Yoga, Bhagavad Gita, Buddhism, Sufism, and Integral Yoga. Science and spirituality (*avidya* and *vidya*). The primacy of self-knowledge in Indian psychology.

2. Research Methodology and Statistics

Research: Meaning, Purpose, and Dimensions.
Research problems, Variables and Operational Definitions, Hypothesis, Sampling.
Ethics in conducting and reporting research

Paradigms of research: Quantitative, Qualitative, Mixed methods approach
Methods of research: Observation, Survey [Interview, Questionnaires], Experimental, Quasi-experimental, Field studies, Cross-Cultural Studies, Phenomenology, Grounded theory, Focus groups, Narratives, Case studies, Ethnography

Statistics in Psychology: Measures of Central Tendency and Dispersion. Normal Probability Curve. Parametric [t-test] and Non-parametric tests [Sign Test, Wilcoxon Signed rank test, Mann-Whitney test, Kruskal-Wallis test, Friedman]. Power analysis. Effect size.

Correlational Analysis: Correlation [Product Moment, Rank Order], Partial correlation, multiple correlation.
Special Correlation Methods: Biserial, Point biserial, tetrachoric, phi coefficient.
Regression: Simple linear regression, Multiple regression.
Factor analysis: Assumptions, Methods, Rotation and Interpretation.

Experimental Designs: ANOVA [One-way, Factorial], Randomized Block Designs, Repeated Measures Design, Latin Square, Cohort studies, Time series, MANOVA, ANCOVA. Single-subject designs.

3. Psychological testing

Types of tests
Test construction: Item writing, item analysis

Test standardization: Reliability, validity and Norms

Areas of testing: Intelligence, creativity, neuropsychological tests, aptitude, Personality assessment, interest inventories

Attitude scales – Semantic differential, Staples, Likert scale.
Computer-based psychological testing

Applications of psychological testing in various settings: Clinical, Organizational and business, Education, Counseling, Military. Career guidance.

4. Biological basis of behavior

Sensory systems: General and specific sensations, receptors and processes

Neurons: Structure, functions, types, neural impulse, synaptic transmission. Neurotransmitters.

The Central and Peripheral Nervous Systems – Structure and functions. Neuroplasticity.

Methods of Physiological Psychology: Invasive methods – Anatomical methods, degeneration techniques, lesion techniques, chemical methods, microelectrode studies. Non-invasive methods – EEG, Scanning methods.

Muscular and Glandular system: Types and functions
Biological basis of Motivation: Hunger, Thirst, Sleep and Sex.
Biological basis of emotion: The Limbic system, Hormonal regulation of behavior.
Genetics and behavior: Chromosomal anomalies; Nature-Nurture controversy [Twin studies and adoption studies]

5. Attention, Perception, Learning, Memory and Forgetting

Attention: Forms of attention, Models of attention

Perception:
Approaches to the Study of Perception: Gestalt and physiological approaches
Perceptual Organization: Gestalt, Figure and Ground, Law of Organization
Perceptual Constancy: Size, Shape, and Color; Illusions
Perception of Form, Depth and Movement
Role of motivation and learning in perception

Signal detection theory: Assumptions and applications
Subliminal perception and related factors, information processing approach to perception, culture and perception, perceptual styles, Pattern recognition, Ecological perspective on perception.

Learning Process:
Fundamental theories: Thorndike, Guthrie, Hull
Classical Conditioning: Procedure, phenomena and related issues
Instrumental learning: Phenomena, Paradigms and theoretical issues; Reinforcement: Basic variables and schedules; Behaviour modification and its applications
Cognitive approaches in learning: Latent learning, observational learning.
Verbal learning and Discrimination learning
Recent trends in learning: Neurophysiology of learning

Memory and Forgetting
Memory processes: Encoding, Storage, Retrieval
Stages of memory: Sensory memory, Short-term memory (Working memory), Long-term Memory (Declarative – Episodic and Semantic; Procedural)

Theories of Forgetting: Interference, Retrieval Failure, Decay, Motivated forgetting

6. Thinking, Intelligence and Creativity

Theoretical perspectives on thought processes: Associationism, Gestalt, Information processing, Feature integration model
Concept formation: Rules, Types, and Strategies; Role of concepts in thinking
Types of Reasoning
Language and thought

Problem solving: Type, Strategies, and Obstacles
Decision-making: Types and models

Metacognition: Metacognitive knowledge and Metacognitive regulation

Intelligence: Spearman; Thurstone; Jensen; Cattell; Gardner; Stenberg; Goleman; Das, Kar & Parrila

Creativity: Torrance, Getzels & Jackson, Guilford, Wallach & Kogan
Relationship between Intelligence and Creativity

7. Personality, Motivation, emotion, stress and coping

Determinants of personality: Biological and socio-cultural
Approaches to the study of personality: Psychoanalytical, Neo-Freudian, Social learning, Trait and Type, Cognitive, Humanistic, Existential, Transpersonal psychology.
Other theories: Rotter's Locus of Control, Seligman's Explanatory styles, Kohlberg's theory of Moral development.

Basic motivational concepts: Instincts, Needs, Drives, Arousal, Incentives, Motivational Cycle.
Approaches to the study of motivation: Psychoanalytical, Ethological, S-R Cognitive, Humanistic

Exploratory behavior and curiosity
Zuckerman's Sensation seeking
Achievement, Affiliation and Power
Motivational Competence
Self-regulation
Flow

Emotions: Physiological correlates
Theories of emotions: James-Lange, Canon-Bard, Schachter and Singer, Lazarus, Lindsley.

Emotion regulation

Conflicts: Sources and types
Stress and Coping: Concept, Models, Type A, B, C, D behaviors, Stress management strategies [Biofeedback, Music therapy, Breathing exercises, Progressive Muscular Relaxation, Guided Imagery, Mindfulness, Meditation, Yogasana, Stress Inoculation Training].

8. Social Psychology

Nature, scope and history of social psychology

Traditional theoretical perspectives: Field theory, Cognitive Dissonance, Sociobiology, Psychodynamic Approaches, Social Cognition.

Social perception [Communication, Attributions]; attitude and its change within cultural context; prosocial behavior

Group and Social influence [Social Facilitation; Social loafing]; Social influence [Conformity, Peer Pressure, Persuasion, Compliance, Obedience, Social Power, Reactance]. Aggression. Group dynamics, leadership style and effectiveness. Theories of intergroup relations [Minimal Group Experiment and Social Identity Theory, Relative Deprivation Theory, Realistic Conflict Theory, Balance Theories, Equity Theory, Social Exchange Theory]

Applied social psychology: Health, Environment and Law; Personal space, crowding, and territoriality.

9. Human Development and Interventions

Developmental processes: Nature, Principles, Factors in development, Stages of Development. Successful aging.
Theories of development: Psychoanalytical, Behavioristic, and Cognitive
Various aspects of development: Sensory-motor, cognitive, language, emotional, social and moral.

Psychopathology: Concept, Mental Status Examination, Classification, Causes

Psychotherapies: Psychoanalysis, Person-centered, Gestalt, Existential, Acceptance Commitment Therapy, Behavior therapy, REBT, CBT, MBCT, Play therapy, Positive psychotherapy, Transactional Analysis, Dialectic behavior therapy, Art therapy, Performing Art Therapy, Family therapy.

Applications of theories of motivation and learning in School
Factors in educational achievement
Teacher effectiveness
Guidance in schools: Needs, organizational set up and techniques

Counselling: Process, skills, and techniques

10. Emerging Areas

Issues of Gender, Poverty, Disability, and Migration: Cultural bias and discrimination. Stigma, Marginalization, and Social Suffering; Child Abuse and Domestic violence.

Peace psychology: Violence, non-violence, conflict resolution at macro level, role of media in conflict resolution.

Wellbeing and self-growth: Types of wellbeing [Hedonic and Eudemonic], Character strengths, Resilience and Post-Traumatic Growth.

Health: Health promoting and health compromising behaviors, Life style and Chronic diseases [Diabetes, Hypertension, Coronary Heart Disease], Psychoneuroimmunology [Cancer, HIV/AIDS]

Psychology and technology interface: Digital learning; Digital etiquette: Cyber bullying; Cyber pornography: Consumption, implications; Parental mediation of Digital Usage.

UNIVERSITY GRANTS COMMISSION
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NET SYLLABUS

Subject: Commerce **Code No. : 08**

Unit 1: Business Environment and International Business
Unit 2: Accounting and Auditing
Unit 3: Business Economics
Unit 4: Business Finance
Unit 5: Business Statistics and Research Methods
Unit 6: Business Management and Human Resource Management
Unit 7: Banking and Financial Institutions
Unit 8: Marketing Management
Unit 9: Legal Aspects of Business
Unit 10: Income-tax and Corporate Tax Planning

Unit 1: Business Environment and International Business

- Concepts and elements of business environment: Economic environment- Economic systems, Economic policies(Monetary and fiscal policies); Political environment- Role of government in business; Legal environment- Consumer Protection Act, FEMA; Socio-cultural factors and their influence on business; Corporate Social Responsibility (CSR)
- Scope and importance of international business; Globalization and its drivers; Modes of entry into international business
- Theories of international trade; Government intervention in international trade; Tariff and non-tariff barriers; India's foreign trade policy

- Foreign direct investment (FDI) and Foreign portfolio investment (FPI); Types of FDI, Costs and benefits of FDI to home and host countries; Trends in FDI; India's FDI policy
- Balance of payments (BOP): Importance and components of BOP
- Regional Economic Integration: Levels of Regional Economic Integration; Trade creation and diversion effects; Regional Trade Agreements: European Union (EU), ASEAN, SAARC, NAFTA
- International Economic institutions: IMF, World Bank, UNCTAD
- World Trade Organisation (WTO): Functions and objectives of WTO; Agriculture Agreement; GATS; TRIPS; TRIMS

Unit 2: Accounting and Auditing

- Basic accounting principles; concepts and postulates
- Partnership Accounts: Admission, Retirement, Death, Dissolution and Insolvency of partnership firms
- Corporate Accounting: Issue, forfeiture and reissue of shares; Liquidation of companies; Acquisition, merger, amalgamation and reconstruction of companies
- Holding company accounts
- Cost and Management Accounting: Marginal costing and Break-even analysis; Standard costing; Budgetary control; Process costing; Activity Based Costing (ABC); Costing for decision-making; Life cycle costing, Target costing, Kaizen costing and JIT
- Financial Statements Analysis: Ratio analysis; Funds flow Analysis; Cash flow analysis
- Human Resources Accounting; Inflation Accounting; Environmental Accounting
- Indian Accounting Standards and IFRS
- Auditing: Independent financial audit; Vouching; Verification ad valuation of assets and liabilities; Audit of financial statements and audit report; Cost audit
- Recent Trends in Auditing: Management audit; Energy audit; Environment audit; Systems audit; Safety audit

Unit 3: Business Economics

- Meaning and scope of business economics
- Objectives of business firms
- Demand analysis: Law of demand; Elasticity of demand and its measurement; Relationship between AR and MR
- Consumer behavior: Utility analysis; Indifference curve analysis
- Law of Variable Proportions: Law of Returns to Scale

- Theory of cost: Short-run and long-run cost curves
- Price determination under different market forms: Perfect competition; Monopolistic competition; Oligopoly- Price leadership model; Monopoly; Price discrimination
- Pricing strategies: Price skimming; Price penetration; Peak load pricing

Unit 4: Business Finance

- Scope and sources of finance; Lease financing
- Cost of capital and time value of money
- Capital structure
- Capital budgeting decisions: Conventional and scientific techniques of capital budgeting analysis
- Working capital management; Dividend decision: Theories and policies
- Risk and return analysis; Asset securitization
- International monetary system
- Foreign exchange market; Exchange rate risk and hedging techniques
- International financial markets and instruments: Euro currency; GDRs; ADRs
- International arbitrage; Multinational capital budgeting

Unit 5: Business Statistics and Research Methods

- Measures of central tendency
- Measures of dispersion
- Measures of skewness
- Correlation and regression of two variables
- Probability: Approaches to probability; Bayes' theorem
- Probability distributions: Binomial, poisson and normal distributions
- Research: Concept and types; Research designs
- Data: Collection and classification of data
- Sampling and estimation: Concepts; Methods of sampling - probability and non-probability methods; Sampling distribution; Central limit theorem; Standard error; Statistical estimation
- Hypothesis testing: z-test; t-test; ANOVA; Chi–square test; Mann-Whitney test (U-test); Kruskal-Wallis test (H-test); Rank correlation test
- Report writing

Unit 6: Business Management and Human Resource Management

- Principles and functions of management

- Organization structure: Formal and informal organizations; Span of control
- Responsibility and authority: Delegation of authority and decentralization
- Motivation and leadership: Concept and theories
- Corporate governance and business ethics
- Human resource management: Concept, role and functions of HRM; Human resource planning; Recruitment and selection; Training and development; Succession planning
- Compensation management: Job evaluation; Incentives and fringe benefits
- Performance appraisal including 360 degree performance appraisal
- Collective bargaining and workers' participation in management
- Personality: Perception; Attitudes; Emotions; Group dynamics; Power and politics; Conflict and negotiation; Stress management
- Organizational Culture: Organizational development and organizational change

Unit 7: Banking and Financial Institutions

- Overview of Indian financial system
- Types of banks: Commercial banks; Regional Rural Banks (RRBs); Foreign banks; Cooperative banks
- Reserve Bank of India: Functions; Role and monetary policy management
- Banking sector reforms in India: Basel norms; Risk management; NPA management
- Financial markets: Money market; Capital market; Government securities market
- Financial Institutions: Development Finance Institutions (DFIs); Non-Banking Financial Companies (NBFCs); Mutual Funds; Pension Funds
- Financial Regulators in India
- Financial sector reforms including financial inclusion
- Digitisation of banking and other financial services: Internet banking; mobile banking; Digital payments systems
- Insurance: Types of insurance- Life and Non-life insurance; Risk classification and management; Factors limiting the insurability of risk; Re-insurance; Regulatory framework of insurance- IRDA and its role

Unit 8: Marketing Management

- Marketing: Concept and approaches; Marketing channels; Marketing mix; Strategic marketing planning; Market segmentation, targeting and positioning
- Product decisions: Concept; Product line; Product mix decisions; Product life cycle; New product development
- Pricing decisions: Factors affecting price determination; Pricing policies and strategies

- Promotion decisions: Role of promotion in marketing; Promotion methods - Advertising; Personal selling; Publicity; Sales promotion tools and techniques; Promotion mix
- Distribution decisions: Channels of distribution; Channel management
- Consumer Behaviour; Consumer buying process; factors influencing consumer buying decisions
- Service marketing
- Trends in marketing: Social marketing; Online marketing; Green marketing; Direct marketing; Rural marketing; CRM
- Logistics management

Unit 9: Legal Aspects of Business

- Indian Contract Act, 1872: Elements of a valid contract; Capacity of parties; Free consent; Discharge of a contract; Breach of contract and remedies against breach; Quasi contracts;
- Special contracts: Contracts of indemnity and guarantee; contracts of bailment and pledge; Contracts of agency
- Sale of Goods Act, 1930: Sale and agreement to sell; Doctrine of Caveat Emptor; Rights of unpaid seller and rights of buyer
- Negotiable Instruments Act, 1881: Types of negotiable instruments; Negotiation and assignment; Dishonour and discharge of negotiable instruments
- The Companies Act, 2013: Nature and kinds of companies; Company formation; Management, meetings and winding up of a joint stock company
- Limited Liability Partnership: Structure and procedure of formation of LLP in India
- The Competition Act, 2002: Objectives and main provisions
- The Information Technology Act, 2000: Objectives and main provisions; Cyber crimes and penalties
- The RTI Act, 2005: Objectives and main provisions
- Intellectual Property Rights (IPRs) : Patents, trademarks and copyrights; Emerging issues in intellectual property
- Goods and Services Tax (GST): Objectives and main provisions; Benefits of GST; Implementation mechanism; Working of dual GST

Unit 10: Income-tax and Corporate Tax Planning

- Income-tax: Basic concepts; Residential status and tax incidence; Exempted incomes; Agricultural income; Computation of taxable income under various heads; Deductions from Gross total income; Assessment of Individuals; Clubbing of incomes
- International Taxation: Double taxation and its avoidance mechanism; Transfer pricing

- Corporate Tax Planning: Concepts and significance of corporate tax planning; Tax avoidance versus tax evasion; Techniques of corporate tax planning; Tax considerations in specific business situations: Make or buy decisions; Own or lease an asset; Retain; Renewal or replacement of asset; Shut down or continue operations
- Deduction and collection of tax at source; Advance payment of tax; E-filing of income-tax returns

UNIVERSITY GRANTS COMMISSION
NET BUREAU

NET SYLLABUS

Subject : Management **Code No. : 17**

Unit – I

Management – Concept, Process, Theories and Approaches, Management Roles and Skills

Functions – Planning, Organizing, Staffing, Coordinating and Controlling.

Communication – Types, Process and Barriers.

Decision Making – Concept, Process, Techniques and Tools

Organisation Structure and Design – Types, Authority, Responsibility, Centralisation, Decentralisation and Span of Control

Managerial Economics – Concept & Importance

Demand analysis – Utility Analysis, Indifference Curve, Elasticity & Forecasting

Market Structures – Market Classification & Price Determination

National Income – Concept, Types and Measurement

Inflation – Concept, Types and Measurement

Business Ethics & CSR

Ethical Issues & Dilemma

Corporate Governance

Value Based Organisation

Unit – II

Organisational Behaviour – Significance & Theories

Individual Behaviour – Personality, Perception, Values, Attitude, Learning and Motivation

Group Behaviour – Team Building, Leadership, Group Dynamics

Interpersonal Behaviour & Transactional Analysis

Organizational Culture & Climate

Work Force Diversity & Cross Culture Organisational Behaviour

Emotions and Stress Management

Organisational Justice and Whistle Blowing

Human Resource Management – Concept, Perspectives, Influences and Recent Trends

Human Resource Planning, Recruitment and Selection, Induction, Training and Development

Job Analysis, Job Evaluation and Compensation Management

Unit – III

Strategic Role of Human Resource Management

Competency Mapping & Balanced Scoreboard

Career Planning and Development

Performance Management and Appraisal

Organization Development, Change & OD Interventions

Talent Management & Skill Development

Employee Engagement & Work Life Balance

Industrial Relations: Disputes & Grievance Management, Labour Welfare and Social Security

Trade Union & Collective Bargaining

International Human Resource Management – HR Challenge of International Business

Green HRM

Unit– IV

Accounting Principles and Standards, Preparation of Financial Statements

Financial Statement Analysis – Ratio Analysis, Funds Flow and Cash Flow Analysis, DuPont Analysis

Preparation of Cost Sheet, Marginal Costing, Cost Volume Profit Analysis

Standard Costing & Variance Analysis

Financial Management, Concept & Functions

Capital Structure – Theories, Cost of Capital, Sources and Finance

Budgeting and Budgetary Control, Types and Process, Zero base Budgeting

Leverages – Operating, Financial and Combined Leverages, EBIT–EPS Analysis, Financial Breakeven Point & Indifference Level.

Unit –V

Value & Returns – Time Preference for Money, Valuation of Bonds and Shares, Risk and Returns;

Capital Budgeting – Nature of Investment, Evaluation, Comparison of Methods; Risk and Uncertainly Analysis

Dividend – Theories and Determination

Mergers and Acquisition – Corporate Restructuring, Value Creation, Merger Negotiations, Leveraged Buyouts, Takeover

Portfolio Management – CAPM, APT

Derivatives – Options, Option Payoffs, Option Pricing, Forward Contracts & Future Contracts

Working Capital Management – Determinants, Cash, Inventory, Receivables and Payables Management, Factoring

International Financial Management, Foreign exchange market

Unit - VI

Strategic Management – Concept, Process, Decision & Types

Strategic Analysis – External Analysis, PEST, Porter's Approach to industry analysis, Internal Analysis – Resource Based Approach, Value Chain Analysis

Strategy Formulation – SWOT Analysis, Corporate Strategy – Growth, Stability, Retrenchment, Integration and Diversification, Business Portfolio Analysis - BCG, GE Business Model, Ansoff's Product Market Growth Matrix

Strategy Implementation – Challenges of Change, Developing Programs Mckinsey 7s Framework

Marketing – Concept, Orientation, Trends and Tasks, Customer Value and Satisfaction

Market Segmentation, Positioning and Targeting

Product and Pricing Decision – Product Mix, Product Life Cycle, New Product development, Pricing – Types and Strategies

Place and promotion decision – Marketing channels and value networks, VMS, IMC, Advertising and Sales promotion

Unit –VII

Consumer and Industrial Buying Behaviour: Theories and Models of Consumer Behaviour

Brand Management – Role of Brands, Brand Equity, Equity Models, Developing a Branding Strategy; Brand Name Decisions, Brand Extensions and Loyalty

Logistics and Supply Chain Management, Drivers, Value creation, Supply Chain Design, Designing and Managing Sales Force, Personal Selling

Service Marketing – Managing Service Quality and Brands, Marketing Strategies of Service Firms

Customer Relationship Marketing – Relationship Building, Strategies, Values and Process

Retail Marketing – Recent Trends in India, Types of Retail Outlets.

Emerging Trends in Marketing – Concept of e-Marketing, Direct Marketing, Digital Marketing and Green Marketing

International Marketing – Entry Mode Decisions, Planning Marketing Mix for International Markets

Unit –VIII

Statistics for Management: Concept, Measures Of Central Tendency and Dispersion, Probability Distribution – Binominal, Poison, Normal and Exponential

Data Collection & Questionnaire Design

Sampling – Concept, Process and Techniques

Hypothesis Testing – Procedure; T, Z, F, Chi-square tests

Correlation and Regression Analysis

Operations Management – Role and Scope

Facility Location and Layout – Site Selection and Analysis, Layout – Design and Process

Enterprise Resource Planning – ERP Modules, ERP implementation

Scheduling; Loading, Sequencing and Monitoring

Quality Management and Statistical Quality Control, Quality Circles, Total Quality Management – KAIZEN, Benchmarking, Six Sigma; ISO 9000 Series Standards

Operation Research – Transportation, Queuing Decision Theory, PERT / CPM

Unit –IX

International Business – Managing Business in Globalization Era; Theories of International Trade; Balance of payment

Foreign Direct Investment – Benefits and Costs

Multilateral regulation of Trade and Investment under WTO

International Trade Procedures and Documentation; EXIM Policies

Role of International Financial Institutions – IMF and World Bank

Information Technology – Use of Computers in Management Applications; MIS, DSS

Artificial Intelligence and Big Data

Data Warehousing, Data Mining and Knowledge Management – Concepts

Managing Technological Change

Unit – X

Entrepreneurship Development – Concept, Types, Theories and Process, Developing Entrepreneurial Competencies

Intrapreneurship – Concept and Process

Women Entrepreneurship and Rural Entrepreneurship

Innovations in Business – Types of Innovations, Creating and Identifying Opportunities, Screening of Business Ideas

Business Plan and Feasibility Analysis – Concept and Process of Technical, Market and Financial Analysis

Micro and Small Scale Industries in India; Role of Government in Promoting SSI

Sickness in Small Industries – Reasons and Rehabilitation

Institutional Finance to Small Industries – Financial Institutions, Commercial Banks, Cooperative Banks, Micro Finance.

BANGALORE UNIVERSITY

M.Sc. Fashion & Apparel Design (CBCS) Syllabus

(I to IV Semesters)

2014-15 onwards

DEPT. OF APPAREL TECHNOLOGY & MANAGEMENT

CENTRAL COLLEGE CAMPUS,

BANGALORE 560001

SEMESTER I
TEXTILE PROCESS AND PRODUCTS

FAD1.1 **No. of Teaching Hours: 52**

Objectives:

- To acquaint students with the requisite knowledge ofprocess to suit the product and fields of application.

Unit 1 **6 Hrs**

Yarn manufacturing process: Ginning – Faults in ginning and controls for optimum ginning. Influence of fibre property on various techniques of spun yarn process. Suitability ofspun yarnsproduced with different techniques for specific products in various fields. Post spinningprocessof spun yarns for efficient performance in further stages of manufacture and uses.

Unit 2 **6Hrs**

Features of various methods of filament yarn production, controls and postspinning requirements.Study of special methods of producing filaments.

Unit 3 **8 Hrs**

Controls in shuttle and shuttles weaving machines.Yarn quality requirements for weaving domestic and export products.

Unit 4 **2 Hrs**

Study of dobby and jacquard woven products.Fabric defects - types, causes and remedies.

Unit 5 **8 Hrs**

Introduction to jacquard knitting machine. Wrap patterning and gaiting of needles. Fabric defects - types, causes and remedies. Knitted fabric structure:Tightness factor, dimensional properties, spirality-relaxation- shrinkage. Dimensional characteristics of warp knits warp knitted fabric geometry - relation between loop length and construction, fabric relaxation and shrinkage.

Unit 6 **10 Hrs**

Non wovens: Definition, Classification, Raw materials, Web formation techniques - dry laid, wet laid. Bonding techniques – mechanical, thermal and chemical.Properties of nonwoven fabrics, products, applications and its characteristics.Braids- constructionmethods, properties, characteristics and application.3 D woven fabrics and their application.

Unit 7 **8Hrs**

Thermal Properties and Comfort: Thermal comfort, concept of heat and mass transfer, thermal protection, moisture vapour transmission, permeability, factors affecting moisture vapour permeability, relationship between moisture vapour permeability and comfort, liquid –

moisturetransmission, water repellency and water absorption., factors affecting liquid – moisture transmission, correlation between air permeability and other factors.

Unit 8 **4 Hrs**

Fabric mechanical properties and tactile pressure sensations: Fabric prickliness, itchness, stiffness, softness, smoothness, roughness, and scratchiness, garment fit and pressure, comfort – general aspects, construction factors, dimensional changes and the effects of fit on comfort.

References:

1. David J Spencer, "Knitting Technology", Wood Head Publishing Limited, England, 2001.
2. Hu, J "Structure and Mechanics of Woven Fabrics", Hong Kong Polytechnic University, Wood Head Publishing Ltd., 2004.
3. Kothari V K,"Fabric Comfort", Proc. of the Seminar on Comfort in Textiles, held at IIT Delhi, New Delhi, 2004.
4. Li Y, "The Science of Clothing Comfort", Textile Progress, Vol.31, No.1/2, The Textile Institute, 2001.
5. Lord P R, "Hand book of yarn production: Technology, Science and Economics", Woodhead Publishing, 2003.
6. SabitAdanur, "Handbook of Weaving", Technomic Publishing Co., Inc., India, 2001.

APPAREL DESIGN

FAD1.2 **No. of Teaching Hours: 52**

Objectives:

- To impart advanced technical skills in pattern making
- To acquaint students with knowledge in designing for special categories.

Unit 1 **6 Hrs**

Introduction to pattern making and clothing construction- terminology, tools and equipments, principles and applications of pattern making techniques-drafting, flat pattern- dart manipulation and draping techniques, Pattern alteration, types of grading.

Unit 2 **4 Hrs**

Design Concepts: Elements and principles of design, application of design concepts in fabrics and fashion products.

Unit 3 **3 Hrs**

Measurements for pattern design- individual and standard measurements, measuring techniques- individual, dress forms, human figure, measurements for fit and pattern size.

Unit 4 **8 Hrs**

Body garment relationship- Ideal figure, figure types, figure analysis, garment design, fabric characteristics & design, structural frame work, contours, proportions, height and weight distribution.

Unit 5 **4 Hrs**

Fitting strategies, fit components, fit evaluation, 3 fitting checks and custom made clothing, commercial patterns.

Unit 6 **10 Hrs**

Designing for special categories: Features and functions of formal, casual and ethnic clothing for various categories and occasions, designing for Infants, maternity wear, plus sizes, elderly citizens, uniforms and physically and mentally challenged.

Unit 7 **5 Hrs**

Intimate apparel, lingerie and other special categories: Evolution of styles from antiquity to modern, design and current trends in intimate apparel, lingerie and body suit categories.

Unit 8 **4 Hrs**

Stitching strategies- stitch classification, securing, temporary, permanent, decorative, principles of hand and machine stitches, stitch and thread selection.

Unit 9 **4 Hrs**

The mechanics of fashion: Role of fashion designers in fashion industry. The fashion design process adapted by designers.Leading fashion designers of India and the world.

Unit 10 **4 Hrs**

Prevailing fashion trends and forecast for fibres, yarns, colours, trends and forecast for various fashion categories for children, men and women.

References:

1. Arnstrong Helen Joseph, Pattern Making for Fashion Design, 3rd edition, Prentice Hall, 1999.
2. Bernard zamkoff and Jeanne Price, creative Pattern "Skills for Fashion Design "Fairchild Publications, 1990.
3. Frances LetoZangrillo, "Fashion Design for the Plus-size", Fairchild Pub., 1999.
4. Gavin Wadddell," How Fashion works", Blackwell Publishing, 2005.
5. Laver, James, "Costumes & Fashions: A concise history". London: Thames & Hudson, 1982.
6. Sharon Lee Tate, "Inside Fashion Design", Harper & Row Pub, NY.

APPAREL TECHNOLOGY I

FAD1.3 **No. of Teaching Hours: 52**

Objectives:

- To provide an insight into technological aspects of apparel manufacturing.
- To familiarize students with various tools &equipments used in apparel production.

Unit 1 **8Hrs**

Introduction to Indian Apparel Industry: Organizational structure and sectors of the garment industry, apparel product types, developments in recent years, opportunities and challenges in Indian apparel sector, over view of global apparel industry, major trends in international apparel technological concepts.

Unit 2 **8Hrs**

Pre production process: Tech pack analysis, sampling, pattern and marker preparation, fabric and accessory procurement, sample types, approvals.

Garment production: Sequence of production operations for shirts, trousers, jackets, skirts and vests.

Unit 3 **10Hrs**

Overview of industrial sewing machines: Features, mechanism, working principle and application of SNLS machine, DNLS machine, over lock machine, blind stitch machine, button sewer and buttonhole machines, bar tack machines.

Study of compatibility of stitch classes and needle types used in industrial sewing machines, seam types and its application.

Selection & application of bed types, machine attachments types, profiles, feed mechanism for different types of fabrics & garment style variation.

Unit 4 **6Hrs**

Fabric spreading technology: Forms of spreading for different types of fabrics, lay types, spreading modes, spreading methods & machines- manual and mechanical methods.

Advanced spreading machines: Semi automatic and automatic-programmable spreading machine

Unit 5 **6Hrs**

Cutting technology: Cutting techniques, considerations of cutting parameters for different fabrics

Cutting machines and its working principle, recent advancements in cutting technology- semi automated and automated cutting machines, working environment and safety measures.

Unit 6 **4 Hrs**

Fusing technology: Fusing materials, components of fusing, types of resin coating & its applications for various apparel products, selection of fusing machines types, working principle and their application.

Unit 7 **4Hrs**

Pressing and folding process: Steam boilers, pressing tables, machinery and equipments, types of folds, folding equipment and accessories.

Unit 8 **6 Hrs**

Packing: Function and scope of packing, packing methods, instructions, materials, weight, ratio, and labelling considerations for shipment by air and sea, packing marks, warehousing - assortment and storage methods.

References

1. Chuter. A. J." Introduction to clothing production management", Blackwell publishing, 2nd Edition, 1995.
2. Claire Shaeffer, "Sewing for the Apparel Industry", Prentice-Hall, 1st Edition, 2001.
3. Gerry Cooklin, "Introduction to Clothing Manufacturers", Blackwell publishing, 2nd Edition, 2006.
4. Harold Carr & Barbara Latham, "The Technology of Clothing Manufacture", Blackwell publishing, 4th edition, 2008.
5. Harold Carr, "The Clothing Factory, Clothing & Footwear Ins1titute", Blackwell Science, 1992.
6. Patty Brown , Jane Rice RN CMA, "Ready-to-Wear Apparel Analysis", Prentice Hall, 3rd Edition, 2000.
7. Richard Jones, "The Apparel Industry", Wiley-Blackwell, 2nd Edition, 2006.
8. Thomas Anna Gawb, "The Art of Sewing", UBS Publishers Distributers ltd. 1994.

RESEARCH METHODOLOGY

FAD1.4 **No. of Teaching Hours: 52**

Objectives:

- To familiarize students with the various types of research, data collection & analysis of research.

Unit 1 **6 hrs**

Meaning and significance of research in management, different approaches to research- scientific method and non scientific methods, types of research.

Unit 2 **6 hrs**

Formulation of research problem, defining research problem, generating research hypothesis, research process, research design, classification of research designs, need for research design, features of good research design, research proposal.

Unit 3 **6 hrs**

Sampling techniques: Steps in sampling, types of sample design – probability and non probability sampling designs, size of sample, sampling errors, concept of measurements and scaling, scaling techniques, characteristics of sound management.

Unit 4 **8 hrs**

Sources of data: Primary v/s secondary data, sources of primary data – observation, interview method, survey method, questionnaire construction and design.

Unit 5 **4 hrs**

Processing of research data: Editing, coding, classification and tabulation.

Unit 6 **8 hrs**

Analysis of the data, comprehension of the analysis, findings and suggestions of the research.

Unit 7 **6 hrs**

Measures of central tendency, measures of variation, measures of dispersion and skewness, test of randomness, Hypothesis testing: Null and alternative hypothesis, level of significance, one and two sample tests, Statistical packages.

Unit 8 **8 hrs**

Report writing: Types of reports, objectives and function of report- formal and informal, report writing process, target audience, pre-research proposals, progress reports, final reports, guidelines for effective writing, research report format, presentation of a report, persuasive nature for effective writing, reports for decision making, technical proposal.

References:

1. Cahoon, Margaret C. “Research Methodology Edinburgh”, Churchill Livingstone, 1987.
2. Kothari, C.R. “Research Methodology: methods and techniques”, New Delhi, VishwaPrakashan, 2nd Edition, 1990.

3. Kumar, Ranjit, "Research Methodology: A step by step guide for beginners", London, Sage publications, 2nd Edition, 2005.
4. Michael P. Marder, "Research Methods for Science", Cambridge University Press, 2011.
5. Velds, Mandy van der. "Guide to management research method" Oxford, Blackwell, 2004.

TEXTILE PROCESS AND PRODUCTS

FAD1.5 **16 Practicals of 4 Hrs each**

Objectives:

- To impart the knowledge oftextile process and theirproducts.
- To familiarize the students with product assessment methods.

Unit 1 **2**

Yarn test for its quality- Yarn unevenness, Hairiness, Strength.

Unit 2 **2**

Collection of yarn samples with associated products.

Unit 3 **4**

Determination of geometric properties of woven and knitted fabrics (10 types).
Wovens:Yarn linear density, GSM, thread density, crimp, cover factor.
Knitted fabrics: Course per inch, wale per inch, thickness, GSM, loop length, count of yarn and tightness of the fabric.

Unit 4 **4**

Structural analysis of woven and knitted fabrics (10 types).

Unit 5 **4**

Assessment of functional properties of fabrics-
water vapour permeability, air permeability, wicking, crease recovery.

DESIGN METHODOLOGY

FAD 1.6 **16 Practicals of 4 Hrs each**

Objectives:

- To develop aesthetic and creative sensibilities and communication.
- To provide a good understanding and application of mixed media, materials, techniques and methods for creative expression.

Unit 1 **4**

Process of motif development:Geometrical, stylized and abstract, enlargement and reduction, various types of repeats and placements for various applications.

Unit 2 **6**

Introduction to traditional and contemporary designs:Design profile of traditional and contemporary design, creating new textures and sketching of traditional and contemporary design using different mediums.

Unit 3 **4**

Thematic process of motif development: Sources for basic sketching and painting.
Inspiration from traditional and contemporary designs: Nature, religion mythology, art, crafts, architecture, historical textiles, paintings from various countries and cultures.

Unit 4 **2**

Product development portfolio with the designs created for apparel and interiors.

GARMENT CONSTRUCTION I

FAD 1.7 **16 Practicals of 4 Hrs each**

Objectives:

- To impart knowledge of drafting and construction of clothing.
- To enable students to understand adaptation techniques of various style features to basic garments.

Unit 1 **2**

Development of basic blocks: men's bodice, women'sbodice.

Unit 2 **2**

Dart manipulation techniques on women's wear.

Unit 3 **2**

Style features-Yoke, pocket design and its variations for women's clothing.

Unit 4 **5**

Designing and stitching of jackets with style variations (2 garments).

Unit 5 **5**

Designing and stitching of women's clothing using dart manipulation techniques and yoke design (2 garments)

COMPUTER AIDED DESIGN

FAD 1.8 **16 Practicals of 4 Hrs each**

Objectives:

- To acquaint students with the application of computers in pattern making.
- To enable the students to develop patterns and grade them to industrial standards.

Unit 1 **1**

Introduction to AccuMark explorer: Pattern design system (PDS) - creating storage area, setting up and editing p-user environment table, notch table and rule table.

Unit 2 **2**

Working tools: Creating and editing points, notches, lines and pieces.

Unit 3 **1**

Digitizing procedure: Pattern preparation, digitizing and verification of patterns.

Unit 4 **4**

Drafting basic blocks, annotation of patterns, modification of patterns as per style requirement of the garment, adding fullness – pleats, gathers, darts, dart manipulation, seam allowances, shaping corners, rotating patterns with accordance to grain line.

Unit 5 **4**

Grading: Selecting grading methods, editing rule table, size range, assigning rule table, grading patterns with x and y co-ordinates.

Unit 6 **3**

Marker making: Marker making procedure, setting up model editor, annotation editor, block buffer editor, lay limit editor and order editor.

Unit 7 **1**

Plotting: Procedure - setting up annotation editor, piece plot parameter and table piece plot order.

KNITWEAR DESIGN AND TECHNOLOGY

FAD1.9A **No. of Teaching Hours: 39**

Objectives:

- To impart knowledge on designing for knitted apparels.
- To acquaint students on various knitwear categories and knitwear apparel production

Unit 1 **3 Hrs**

Introduction to knitted fabrics.Difference between knits and wovens, Indian knitting industry – past, present and future.

Unit 2 **4 Hrs**

History of knitting, Hand knitting, terms used in knitting, weft knitting & warp knitting – introduction and comparison. Parts and functions of weft knitting and warp knitting – calculations used in knitting.

Unit 3 **4 Hrs**

Yarns used for knitting-cotton, wool, nylon, acrylic, high bulk acrylic, spandex, etc. Properties of knits for apparel production –stretch and shrinkage factors.

Unit 4 **4 Hrs**

Wefts knit structures – single jersey or plain – rib – purl – interlock – Knit float-tuck and stitch structures – designing of weft structures. Warp Knit Fabrics –warp knit structures – underlap – overlap – closed lap and open lap stitches.

Unit 5 **2 Hrs**

Latest Knitting machines, weft –knitting machines- warp knitting machines – Knitted fabric defects.

Unit 6 **6 Hrs**

Knitwear production-Machineries: Flat bed, circular & stock knitting machines, categories of knitted garments –fully cut, stitch shaped cut, fully fashioned and integral garments, seams, seam finishes & stitches, machinery used,pre-production and production, finishing and precautions in apparel production.

Unit 7 **4 Hrs**

Knitted garment manufacture: Cutting – stitching – quality control of knitted garments- knit wear garment designs and developments.

Unit 8 **4 Hrs**

Introduction to knitted apparels- apparel categories-men, women and children casual, formal/sportswear, sweaters and hosiery.

Unit 9 **3 Hrs**

Quality control of knitted garments-Fabric quality-weight per unit area, tightness factor, knitted faults, pilling. Garment quality-spreading, cutting, sewing and final inspection.

Unit 10 **5 Hrs**

Introduction to knitwear designing-Factors influencing knitwear designing, fashion as applied to knitwear-past present and future. Innovations in knitwear-Recent trends in knit wear-seamless garment construction, surface embellishments on knitwear, knits in interiors and computer aided designing in knitwear.

References:

1. David Spencer, "Knitting Technology", Pergamon Press, Oxford, 2001.
2. George A Tay, "Fundamentals of weft knitted fabrics", National Knitwear and Sportswear Association, New York, USA, 1996.
3. Jay Diamond, Ellen Diamond, "The World of Fashion", 3rd Edition, Fairchild Publication, 2002.
4. Sandy Black, "Knitwear in Fashion", Thames and Hudson Publication, 2002.
5. TerrryBrackenbury, "Knitting Clothing Technology", Blackwell Publishing, 2005.

WORLD TEXTILES & COSTUMES

FAD 1.9B **No. of Teaching Hours: 39**

Objectives:

- To acquaint students with textiles and costume designs of different regions during different periods.

Unit 1 **2Hrs**

Introduction to textiles and costumes of world: History of fashion, psychology of clothing, factors influencing costumes.

Unit 2 **5Hrs**

Historic costumes: Costumes, head dress, hair style and accessory of head dress and accessories of ancient world- The ancient middle east -3500-600BC- Mesopotamian, Egyptian, Roman, Byzantine, Greece, old English and French, Victorian Period, French Revolution, Renaissance costumes, Boroque and Rococo.

Unit 3 **4Hrs**

Textiles and costumes of eighteenth and nineteenth century – The American colonies, French, England, Italy and Austria, Directoire period (1790-1820), Romantic period (1820-1850), Crinoline period(1850-1869),The Butle period(1870-1900).

Unit 4 **6Hrs**

Introduction to the traditional textiles and costumes of ancient India - Indus valley civilization, Mauryan and Sunga, Satvahana period, Kushan Period, Gupta and Mughal period.
Contemporary Indian costumes of different states of India: East, West, North and South states

Unit 5 **6Hrs**

The ancient world textiles: The Mediterranean, central and north Europe, The Middle Eastern textiles- Sassanian, early Islamic, Byzantine silks, Safavid Iran(1499-1722), The Ottoman empire, Central Asian textiles- Republics of Turkmenistan, Uzbekistan, Tadzhikistan, Kirghzia and Kazakistan, Iran and Afghanistan,Portugues carpets.

Unit 6 **4 Hrs**

Textiles and costumes of Asia: Historic background and trade, Textiles from Pakistan, China, Japan, Thailand, Myanmar, Laos and Cambodia, Philippines, Indonesia, Malaysia.

Unit 7 **6 Hrs**

Textile and costumes of Western Europe: Silian Silks, Italian Silks, Spanish silks, French silks, figured linen damasks from Netherland, French tapestries, Italian embroidery and lace and printed textiles. Textile and costumes of Eastern Europe: Embroidered textiles from Hungary, Greece.

Unit 8: **3Hrs**

Textile and costumes of Colonial North America (1700-1990), Native North America, LatinAmerica.

Unit 9 **3Hrs**

Textile and costumes of Africa: Traditional designs, Gold embroidery of North Africa, Ghana, Kuba and Madagascar.

References

1. Chas A, "Historic Costume", Bernard and Co, 1961.
2. Das S N , "Costumes of Indian and Pakistan", D B TaraporevaIa Sons & Co, Bombay, 1958.
3. Doreen Yarwood "Illustrated Encyclopedia of World Costume"Dover Publications, 2011.
4. Hart A North S V and A Museum, "Historical Fashion in detail the 17th and 18th Centuries", McMillan, India, 1998.
5. John Gillow, Bryan Sentance, "World Textiles: A Visual Guide to Traditional Techniques", Thames &Hudson , 2005.

SEMESTER II

CHEMICAL PROCESSING & FINISHING

FAD 2.1 **No. of Teaching Hrs. 52**

Objectives

- To acquaint students with modern concepts in dyeing, finishing & bio processing.
- To enable students to understand energy conservation & pollution control approaches in textile processing.

Unit 1 **4 Hrs**

Preparatory processes: Desizing, Scouring, Bleaching, Mercerization.

Unit 2 **10Hrs**

Dyeing: Introduction, classification, Theory of Dyeing, Application of dyes- direct, basic,acid, vat, reactive, sulphur and disperse dyes. Eco-friendly dyeing, Natural dyes – importance and applications.

Unit 3 **6Hrs**

Developments in the application of direct, reactive, disperse dyes to textile materials using batch wise and continuous methods,Waterless dyeing.

Unit 4 **4 Hrs**

Printing with different dye classes: Direct, resist and discharge styles of printing - Transfer printing of polyester and blends, Digital printing.

Unit 5 **8Hrs**

Chemical finishing: Application of water repellent/proof, flame retardant, mildew proof, moth proof, anti-static, soil release, UV protection, anti microbial, odour control and fragrance finishes, resin finishing: durable press, wrinkle free, silicone finishing.

Unit 6 **6 Hrs**

Garment Processing & finishing: Processing of grey fabric garments, garment dyeing, machinery for garment dyeing, garment finishing and printing.

Unit 7 **4Hrs**

Denim finishing: Process conditions, machineries, chemicals and enzymes used for various special effects, stone wash, enzyme wash, biopolishing&biostoning, sand blasting, ozone and laser fading.

Specialty garment finishes: Leather finish, rubbery touch, feather touch, peach skin finish.

Unit 8 **4 Hrs**

Application of enzymes in processing: Mechanism of enzyme reactions – Bio scouring and Bio-bleaching and the other combined processes. Enzyme washing.

Unit 9 **6Hrs**

Energy conservation steps in chemical processing: Low wet pick-up techniques - causes and remedies for water and air pollution. Wastewater characteristics; wastewater treatment - objectives, methods and implementation considerations, recycling of effluents, low cost adsorbents and modern effluent treatment processes.

References:

1. Broughton, Kate, "Textile Dyeing: The step-by-step guide" Rockport, 2001.
2. Chritie R., "Environmental aspects of textile dyeing", Woodhead Publishing Ltd, UK, 2007.
3. Heywood, Derek, "Textile Finishing: Society of Dyers and Colourists", 2004.
4. Leslie W.C. Miles: "Textile Printing: Society of Dyers &Colorists Dyers Company", 2003.
5. Lueas.J. et al, "Colour Measurement – Fundamentals", Vol.1, Eurotex 1996.
6. Shenai V A, "Technology of Textile Finishing", Sevak Publications, Mumbai, 1995.
7. Tobler-Rohr M I, "Handbook of sustainable textile production", Woodhead Publishing Ltd, UK, 2011.
8. Venkatraman.K,, "Chemistry of Synthetic Dyes" Vol. III, Academic Press, New York, 1991.

APPAREL TECHNOLOGY II

FAD 2.2 **No. of Teaching Hours: 52**

Objectives:

- To endow students with the advanced apparel production process and systems.
- To make the students aware ofdevelopments in apparel industrial engineering concepts.

Unit 1 **3Hrs**

Introduction to core concepts of apparel production: Evolution of apparel production processes; mass production concepts and standardization of sizing, various production systems practiced in India and their application for different apparel products, emerging trends in apparel production processes.

Unit 2 **4Hrs**

Introduction to apparel industrial engineering concepts: Evolution of industrial engineering, scope of industrial engineering in global perspective, IE interface with apparel production.

Unit 3 **3 Hrs**

Operator training and development: Classification of sewing operators, need based training-primary and secondary training, training modules, multi skilled operator development, adaptation of performance improvement methods, reasons of training failure, retraining on low performance key areas, improving effectiveness of training.

Unit 4 **3Hrs**

Elements of production planning and control: Task scheduling, material resource planning, process selection and planning, basic capacity calculation,estimating quantity & costs of production.

Unit 5 **6Hrs**

Production plant layout and material handling: Principles of plant layout, plant layout considerations; integration of workmen, material and machines, minimum movement, safety measures, maximum visibility, material handling techniques- application of advanced material handling equipments to eliminate non productive movements, minimum handling of materials.

Unit 6 **8 Hrs**

Work study: Method study approach, work measurement; tools and techniques, principles of motion economy, ergonomics, SAM calculation methods, work elements, basic motion elements, predetermined motion time standards, micro and macro motion charts; operation process chart, flow process chart, string diagram, efficiency indices.

Unit 7 **4Hrs**

Line planning: Line requirement parameter considerations based on type of apparel product, SAM, order quantity, lead time, factory efficiency.

Men and machine requirements planning, batch setting, line balancing concepts, elimination of bottlenecks.

Unit 8 **6 Hrs**

Productivity management: Overview of productivity measures, measuring labour productivity, machine productivity & value productivity, strategies to improve productivity, factors affecting productivity, balancing productivity and quality.

Unit 9 **4 Hrs**

Performance appraisal (PA): Analysis and development, criteria for PA, techniques of PA, employee turnover, absenteeism, attrition and retention, industrial hygiene and safety standards

Unit 10 **8 Hrs**

Emerging trends in apparel production concepts: Lean manufacturing concepts, lean principles, six sigma, theory of constraints (TOC), lean tools; muda, just in time, 5s, total productive maintenance(TPM), kanban, kaizen, KPI, poka yoke, PCDA, SMED, value stream mapping, tact time calculation, root cause analysis.

Unit 11 **3 Hrs**

Innovative trends and challenges in apparel production: IT applications in capturing motion economy and time measurement, lowering energy consumption and minimizing environmental impact.

References

1. Eberle, Hannelore, "Clothing technology: from Fibre to Fashion, Verlag Europa-Lehrmittel, Nourney, Vollmer GmbH & Co., 5th Edition, 2008.
2. Grace I. Kunz "Going Global: The Textile and Apparel Industry", Fairchild Books, 2nd Edition, 2011.
3. Grace I. Kunz, Ruth E. Glock, "Apparel Manufacturing: Sewn Product Analysis", Pearson/Prentice Hall, New Jersey, 4th edition, 2005.
4. JanaceBubonia. "Apparel Production Terms and Processes", Fairchild Books, 2nd Edition, 2011.
5. Paula J. Myers-McDevitt, "Apparel Production Management and the Technical Package" Bloomsbury Academic, 2010.

APPAREL COSTING

FAD 2.3 **No. of Teaching Hours: 52**

Objectives:

- To familiarize students withapparel costing methods and techniques.

Unit 1 **8 hrs**

Cost accounting: Classification of cost elements- direct and indirect. Determination of factory cost, administration cost and sales cost of an apparel product. Manufacturing cost account statement - preparation and analysis, cost behavior patterns – fixed, variable, semi variable. Calculations related to job order costing and process costing.

Unit 2 **6 hrs**

Accounting for factory overhead: Capacity level concepts, production and service departments, indirect costs, over and under applied overhead.

Unit 3 **8 hrs**

Cost volume profit analysis: Break-even analysis, Contribution margin, variable, cost ratio, marginal income. Sales mix by garment style, effect of volume change, price/volume analysis.

Unit 4 **8 hrs**

Standard Costing: Variance analysis, setting cost standards, price variance analysis for material, labour and overheads. Determination of standard cost for weaving, knitting and processing cost of woven/knitted fabrics. Fabric cost – stripe/ checked, printed and embroidery and special finished goods.

Unit 5 **6 hrs**

Determining pricing of apparels: Price elasticity of demand and supply,Sample costing-marginal revenue and marginal cost. Assortment order planning -cost determination, size and colourwise – men's, women's and children's wears.

Unit 6 **8 hrs**

Pricing methods: Cost plus pricing methods / full cost pricing, conversion cost pricing, differential cost pricing; variable cost pricing, direct cost pricing. Derivation of cost of apparel products – woven / knits. CM, CMT cost analysis for various styles. Activity based costing, Cost analysis for various styles of garments. FOB/CIF/C&F pricing of apparels.

Unit 7 **8 hrs**

Budgeting process: Budgeting principles for the apparel industry, fixed vs. flexible budget, master budget, limitations of budgets. Project proposal for setting up a new garment unit.

References

1. Bhabatosh Banerjee, "Cost Accounting", Word Press, 11th Revised Edition, 2001.
2. Blocher, Edward, "Cost Management: A strategic Emphasis", McGraw Hill, London, 2002.

3. Hansen, Don R, “Cost Management Accounting and Control”, Ohio Thomson, 4th Edition, 2003.
4. Hilton, Ronald W, “Cost Management: Strategies for Business Decisions”, McGraw Hill, London, International Edition, 2000.
5. Richord D Irwin, “Principles of Cost Accounting: Managerial Applications”, Excel books, India, 2001.
6. William Lanen, “Fundamentals of Cost Accounting”, McGraw-Hill/Irwin, 3rd Edition, 2010.

FASHION MERCHANDISING ANDMARKETING

FAD 2.4 **No. of Teaching Hours: 52**

Objectives

- Toacquaint students with fashion merchandising and marketing concepts.
- To endow students with a broad perspective on emerging trends in merchandising & challenges in marketing.

Unit 1 **3Hrs**

Introduction to merchandising: Evolution, merchandising types, basic functions of merchandising, merchandising technology, merchandiser's key responsibilities.

Unit 2 **3 Hrs**

Domestic and export marketing: Study of market, market structure, market types, business strategic planning, micro and macro environments, market development, problems and benefits.

Unit 3 **4Hrs**

6 R's of fashion merchandising, fashion forecasting, fashion interpretation, merchandise resource planning, elements of planning, capacity planning, merchandising calendar, KPI measurements, buying and selling seasons in different market.

Unit 4 **6 Hrs**

Market Research: Research types, research objectives, developing research plan, methods of sampling, data source & collection methods, data analysis, presenting findings, interpretation and implementation.

Unit 5 **2 Hrs**

Consumer behaviour, target market and market segmentation.

Unit 6 **4 Hrs**

New product line development: Types of products, study apparel product lines, product life cycle, brand management, idea generation, screening, concept testing, test marketing, commercialization, product positioning, major reasons for product failure.

Unit 7 **4 Hrs**

Preproduction activity: Pre-production & TNA meetings, sampling-developing samples, sample types, sample approvals, lab dip, yarn dip, bit loom, strike offs, pre-costing and order follow-up.

Unit 8 **8Hrs**

Purchase Management: Role and responsibilities of purchase department, purchase cycle, global sourcing methods, identification of vendors, vendor analysis, evaluation of vendor, ratings criteria and selection procedure, negotiation and bargaining, vendor relations

Order confirmation, consumption, final costing, pricing, purchasing of raw materials, bill of materials, trim card, production file, and production follow-up.

Unit 9 **10Hrs**

Marketing mix, assortment and range planning, promotional techniques, distribution channels, market intermediaries & logistics management.

Retail formats: Organized, unorganized formats, types of retail stores – convenience stores, super markets, departmental stores, hyper markets, lifestyle stores, franchisee outlets & specialty stores.

Unit 10 **8Hrs**

Emerging trends and issues in marketing: Consumerism, rural marketing, social marketing, online marketing, and green marketing.

Quality assurance and IT application in merchandising, Textile and apparel policies- FDI policies in retail sector.

References

1. Del Hawkins, David Mothersbaugh , AmitMookerjee, "Consumer Behavior: Building Marketing Strategy", Tata McGraw Hill Education, 11th edition, 2012.
2. Donnellan, John, "Merchandise Buying and Management", Fairchild Books, 3rd Edition, 2007.
3. Grace I. Kunz, "Merchandising: Theory, Principles, and Practice", Fairchild Books, 3rd Edition, 2009.
4. Jeremy A. Rosenau, David L. Wilson, "Apparel Merchandising - The Line Starts Here", Fairchild Books, 3rd Edition, 2006.
5. Jung E. Ha-Brookshire, "Global Sourcing in the Textile and Apparel Industry", Prentice Hall, 1st Edition, 2014.
6. Philip Kotler , Kevin Keller, "Marketing Management", Prentice Hall, 14th Edition, 2011.

CHEMICAL PROCESSING & FINISHING

FAD 2.5 **16 Practicals of 4 Hrs each**

Objectives:

- To familiarize students with chemical processing techniques.
- To impart the skills of preparation and dyeing of textiles.

Unit 1 **4**

Pre-processing of textiles: Desizing, degumming, scouring, bleaching, bio polishing, optical whitening, mercerization.

Unit 2 **1**

Water quality analysis: hardness, pH, salinity, TDS.

Unit 3 **7**

Dyeing: Dyeing textiles with direct, acid, basic, reactive, disperse, sulphur, vat dyes & natural dyes.Assessment of colour fastness of dyed samples.

Unit 4 **1**

Colour measurement: Determination of K/S values and colour difference of dyed fabrics

Unit 5 **1**

Printing: Priniting of cotton by direct technique

Unit 6 **2**

Effluent analysis: COD, BOD, pH, TS, TDS.

GARMENT CONSTRUCTIONII

FAD 2.6 **16 Practicals of 4 Hrs each**

Objectives:

- To familiarize students with spec sheet analysis, garment construction and its evaluation.
- To acquaint students with garment quality tests and assessment methods.

Unit 1 **3**

Development of basic block for men using flat pattern and draping technique.

Unit 2 **2**

Development of collar, sleeve, pocket, cuff & placket design and its variations

Unit 3 **6**

Design and construction of men's clothing (upper garment & leg wear) and develop a spec for the same.

Unit 4 **1**

Analyse the constructed garments using standard methods.

Unit 5 **2**

Garment quality test for dimensions, stitches, seam appearance, seam strength, seam slippage.

Unit 6 **2**

Garment accessory tests: Buttons impact and compression tests, zippers test, hooks and loop fastener tests

PROJECT WORK

FAD 2.7 **8 Hrs/week**

Students have to undertake project in the relevant areas of apparel manufacturing. At the end of the first semester, students have to submit the project proposal for approval. The project work shall be carried out during the II Semester either in the Department or at an approved industry / organisation under the supervision of the guide. Three copies of the project reports are to be submitted to the Department through the guide before the commencement of II Semester examination.

TEXTILES FOR INTERIORS

FAD 2.8 A **No. of Teaching Hrs. 39**

Objectives:

- To enable students to understand various textiles used in interiors.
- To impart knowledge on various application of textiles in interiors.

Unit 1 **4 hrs**

Fundamental principles of interior textiles: classification of interior textiles. Types -Natural and synthetic fibres for interior textiles; the use of knitted, woven and nonwoven fabrics in interior textiles. Their characteristics and application in interiors.

Unit 2 **4 hrs**

Interior textiles from antiquity to modern -Surface design of fabrics for interior textiles.Use of textiles in carpets and floor coverings. Special finishes for carpets and floor coverings, its care and maintenance.

Unit 3 **4 hrs**

Developments in interior textiles: Upholstery fabrics for interiors. Methods and innovative textiles for seating.Advances in joining fabrics for the furniture industry.

Unit 4 **4 Hrs**

Development and characteristics ofinterior textiles for automotive, locomotives and aeroplanes.

Unit 5 **4 Hrs**

Development and characteristics ofinterior textiles for hospitals and hospitality industry.

Unit 6 **6 hrs**

Developments in special finishing treatments for interior textiles: Soil and stain resistant finishes, Fragrance textiles, odour resistant, antimicrobial finishes, flame retardant, Fire testing of upholstered furniture. Testing standards and evaluation of risk analysis.

Unit 7 **5 hrs**

Fabrics for soft furnishing: Textiles for carpets, durries, tapestries, drapery, upholstery, wall coverings. Home furnishing - their properties, uses and application in the interiors, other materials used for interior textiles- Cork, leather, paper, Rexene etc.- their properties, uses and applications in the interiors.

Unit 8 **4 hrs**

Environmental issues in interior textiles: A brief overview of green materials used for textiles for interiors. Role of textiles in indoor environmental pollution- problems and solutions.

Unit 9 **4 Hrs**

Current trends and forecast on interior textiles.

References:

1. Chambers B.G. “Colour and design, Fashion in Men’s Women’s Clothing and furnishings” Prentice Hall. Inc. Newyork, 1951.
2. Erwin, Kinchen and Peter, “Clothing for Moderns” Mcmillan publishing compare, In. New York, 6th Edition, 1976.
3. Gisela Hein, “Fabric printing”, B.T. Batsford Ltd, London, 1972.
4. Hamyln, “Mc.Calls Sewing in Colour”, The Hamyln Publishing Corporation limited, 1975.
5. JasleenDhamija, “The Indian Folk, Arts and Crafts”, National Book Trust India, NewDelhi, 1992.

ECO TEXTILES AND SUSTAINABLE CLOTHING

FAD 2.8 B **No. of Teaching Hrs. 39**

Objectives: To acquaint students with eco-friendly processes and products.

Unit 1 **8hrs**

Introduction: Differences between chemical & green processes, rules/recommendations for using chemicals, raw materials & waste handling for sustainable textiles & clothing.

Unit 2 **10hrs**

Eco-friendly chemical processing: Modern approaches to eco-friendly wet processing of woven and knitted clothing. Red listed textile chemicals, their sources and remedies. Eco-friendly dyes and their method of dyeing.Energy efficient production methods and processing techniques. Eco-labeling and various eco-standards, enzymes and natural dyes.

Unit 3 **6hrs**

Quality standards and assessment of Eco-textiles:Oekotex standards, GOTS standards: certification procedures and implementation, ISO 14000 & EMS: guidelines and implementation. Toxicology of textile dyes and chemicals, eco- parameters and testing of various toxic chemicals and dyes.

Unit 4 **6 hrs**

Organic and Sustainable textiles: Organic fibre production & processes- cotton, wool silk, bamboo, Regenerated fibres- Lyocell, PLA, Recylcedfibres- PET. Reduction of carbon footprints in textile processing.

Unit 5 **4 Hrs**

Introduction and importance of recycling and up cycling for growing source of innovative design in the fashion and accessories, processing, production and their applications.

Unit 6 **5hrs**

Manufacturing rights-Ethical and environmental issues relating to textiles and fashion industry. Ethical, standard practices for sourcing of sustainable fashion clothing and accessory.Corporate social responsibility in fashion and apparel industry.

References:

1. Blackburn R S, 'Sustainable textiles: Life cycle and environmental impact', Woodhead Publishing Ltd, UK, 2009.
2. Christie R., "Environmental aspects of textile dyeing", Woodhead Publishing Ltd, UK, 2007.
3. Moore M.A "Environmental impact of textile production, Fairchild books, New York 2008.
4. Skelly J. K., "Water Recycling in Textile wet Processing", Woodhead Publishing Ltd, UK, 2003.

5. Trivedi R.K., “Handbook of Environmental laws, Acts, Guidelines, Compliances and Standards”, Vol. 1, Enviro Media, India, 1996.

SEMESTER III

APPAREL QUALITY CONTROL AND STANDARDS

FAD 3.1 **No. of Teaching Hrs. 52**

Objectives:

- To impart skills for analysis of garment specification sheets and to translate them into quality output.
- To familiarize students with advanced apparel quality tests and standards

Unit 1 **8Hrs**

Introduction to quality control and standards: Evolution of quality, quality planning, quality control, quality assurance, total quality management-contributions of Deming, Juran and Crosby, Quality Management System- Organizing, planning and implementation.

Quality standards: importance, benefits, levels and sources of standards- ISO, AATCC, ASTM, BS, BIS, DIN.

Unit 2 **6 Hrs**

Quality Specifications: Yarns, fabrics & trims defect analysis and rectification.

Garment Standards and Specifications: Analysis of pre-sample specification of garment or apparel product, understanding quality assurance in terms of measurement, sewing operations and finishes as per the specification sheet and garments defect analysis.

Unit 3 **8Hrs**

Eco management of textile and apparel industry: Global scenario, eco textiles, eco standards and certifications - ISO 14000, Eco-mark, Oeko Tex 100 standards, GOTS, OHSAS, Green label, Green Seal.

Eco specifications and restrictions in apparels and textiles: Sensitizing dye stuffs, allergic dyes, carcinogenic anions, red listed as per eco specifications, chemicals used in dry cleaning which deplete ozone, pH value, formaldehyde contents, heavy metal contents, pesticides and herbicides, azoic dyestuffs nickel pentachlorophenol, colourfastness, brighteners, softening agents, etc.

Unit 4 **8Hrs**

Fabric hand characteristics- Drape, bending, crease recovery, shear, bias extension, formability, friction- objective measurement by FAST & KES.

Serviceability: Snagging, pilling, abrasion resistance, tearing strength, tensile, bursting, seam strength, seam slippage, flammability, soil resistance, soil release.

Unit 5 **8Hrs**

Aesthetics-Colour measurement, shade variation and colour fastness to washing, light, perspiration, crocking and other agencies.

Hygralexpansion, relaxation shrinkage- methods of measuring dimensional change to dry cleaning, dry heat and steam.

Transmission characteristics – air permeability, heat transmission, light permeability, moisture transmission and water permeability.

Unit 6 **6Hrs**

Garment Quality tests for dimensions, fabric construction, weight, properties, stitch lines, seams, special stitches, finishes etc.

Durability characteristics of trims - resistance of zippers, buttons, snaps, buckles etc. to abrasion, bursting and corrosiveness.

Unit 7 **4Hrs**

Labelling: Introduction, labelling parameters, fibre content, care labelling and flammability, wash care labels, labelling systems - Canadian, American, European, Australian, Sweden, UK, Germany and Japan, Regulations for labeling parameters, Eco-labelling.

Unit 8 **4 Hrs**

Garment defects: Cutting defects, sewing defects, assembly defects, pressing, finishing and packaging defects, and procedures of quality evaluation, revision and approvals as specified in the specification sheet.

References

1. David H, "ISO 9000 quality system handbook", Butterworth publishing, New Delhi, 2006.
2. Juran J M and Gryna, F M, "Quality Planning and Analysis - From Product Development through Use", Tata McGraw Hill Publishing Limited, New Delhi, 2001.
3. Pradeep V Mehta, "Managing Quality in Apparel Industry", NIFT publication.
4. Sara J Kadolph, "Quality Assurance for Textiles and Apparels", Fairchild publications, 2nd Edition, 2007.
5. Saville, B.P. "Physical testing of textiles", Woodhead Publishing Ltd and CRC Press LLC, 1999.

FASHION ACCESSORY DESIGN

FAD 3.2 **No. of Teaching Hrs. 52**

Objectives:

- To make students understand current accessory categories trends, designs, materials selection, production process, costing and marketing aspects

Unit 1 **10Hrs**

Introduction to Fashion Accessories: Categories for men, women and children, functions and features, inspirations, analyse forecasting reports different sources, accessory trend reports, designing aspects, selection of colours, materials, with relation to clothing line.

Unit 2 **8Hrs**

History of jewellery from various cultures, gemology and categories of traditional and contemporary jewellery, production and processing procedure, beading techniques with application on earrings, bracelets, and neckpiece, current trends in jewellery.

Unit 3 **8 Hrs**

Designing with leather and fur: Evolution categories, sources, production and processing procedure, design and current trends in leather and fur, laws and regulation for production, marketing and labelling of leather and fur products.

Fashion leather goods: Belts, shoes and socks and shoe accessories, bags, clutches and travel accessories.

Unit 4 **6Hrs**

History of headgears from various cultures, categories, styles, materials used and current trends. Hair accessories and hair adornments.

Unit 5 **4 Hrs**

Scarves and wraps: Current trends, materials used and style features.

Unit 6 **6Hrs**

Lifestyle and tech accessories: Sunglasses and readers, materialsused and manufacturing process, current trends in sunglasses and readers.

Unit 7 **6 Hrs**

Trends in imitation jewellery: Design, inspirations, production process, compatibility of design conceptsbetween materials used and style characteristics with clothing line.

Unit 8 **4 Hrs**

Major fashion accessory houses, inspirations, product releases, marketing overview.

References:

1. Judith C. Everett , "Guide to Producing a Fashion Show" Fairchild Books, 3rd Revised Edition, 2013.
2. Olivier Gerval, "Fashion Accessories" (Studies in fashion), Firefly Books, 2010.

3. Frings, Gini Stephens, “Fashion: From Concept to Consumer”, Prentice Hall, 9th Edition, 2007.
4. John Peacock, “Shoes: The Complete Sourcebook”, Thames & Hudson Ltd., 2005.
5. John Peacock, “Fashion Accessories: The Complete 20th Century Sourcebook”, Thames and Hudson, 2000.

RETAIL MANAGEMENT

FAD 3.3 **No. of Teaching Hrs. 52**

Objectives:

- To make the students understand retailing as an industry.
- To acquaint the students with knowledge & skills for store operations, retailing marketing & merchandising management functions.

Unit 1 **4 Hrs**

Overview of Retailing Environment, Store Formats – Types of Retailers and types of Ownerships, Elements of Retail Mix, Store Organizations, Retail Market Strategy

Unit 2 **3 Hrs**

Trade area analysis and site selection, Location advantage and disadvantage

Unit 3 **6 Hrs**

Departmentalization, Layout planning and space allocation, Basic Profit Factors – The Relationship of Markup to Profit, Retail pricing & re-pricing

Unit 4 **8 Hrs**

Retail Market structure, retail functions & distribution, channels of distribution, sorting process, relationship between retailers & their suppliers, wholesaling, exclusive distribution, intensive distribution, selective distribution, marketing concepts in retailing, structure of global retail markets & consumers, profile of Indian retail markets

Unit 5 **6 Hrs**

Retail Store Business Plan, profit planning, net profit margins, returns on assets, budgeting decisions, magnitude of various costs, productivity targets, operating expenses

Unit 6 **6 Hrs**

Store operations; Store formats, size & space allocation, operating functions to be performed, personnel utilization, store maintenance, energy management & renovations, inventory management, credit management, computerization, crisis management, insurance

Unit 7 **4 Hrs**

Inventory Methods, Six months buying plans – stock turn, open to buy

Unit 8 **8 Hrs**

Sales promotion techniques, advertising, public relations, personnel selling, publicity, role of salespersons, word of mouth, incremental promotion method, distributed promotion method, setting retail promotion goals.

Unit 9 **3 Hrs**

Customer Service; Loyalty Programmes and Customer Relationship Management

Unit 10 **4 Hrs**

Strategic Profit Model, Retail Mathematics, Retail balance sheets, calculations involving net profit margins, asset turnover, returns on assets, financial leverage, quick ratios, current ratios, collection periods, profits & networths, cash inflow & cash outflow, productivity, sales to stock ratio.

1. **References:**

1. Barton A Weitz, "Retail Management" McGraw-Hill Higher Education, 9th Edition, 2013.
2. Barry R Berman, Joel R. Evans, "Retail Management: A Strategic Approach", Prentice Hall, 12th Edition, 2012.
3. Bette K. Tepper, "Mathematics for Retail Buying 6th Edition", Fairchild Books, 6th revised edition, 2008.
4. David Gilbert, "Retail Marketing Management", Financal Times Management, 2nd Edition, 2003.
5. Hasty, Ronald W. "Retail management", New York: McGraw-Hill, 1997.
6. Ghosh, Avijit. "Retail management, Fort worth: Dryden Press, 2nd Edition, 1994.
7. James C. Makens, Robert G. Roe, "Retail management: Satisfaction of consumer needs", Chicago: Dryden, 3rd Edition, 1983.

FASHION DRAPING

FAD 3.4 **16 Practicals of 4 Hrs each**

Objectives:

- To impart in depth knowledge of draping techniques.
- To understand and analyze draping behaviour of different textile materials.

Unit 1 **1**

Introduction to draping: Draping terminology, tools and equipments, dress forms, elements of fabric behaviour, principles and techniques of draping.

Unit 2 **4**

Draping of foundation patterns-Basic bodice, basic skirt / trousers, basic sleeve- Children and adults

Unit 3 **5**

Designing draped garments based on theme using following components with different fabrics
a. Bodice variations- dartless silhouettes, princess shape.
b. Midriffs &Yokes
c. Collars
d. Cuffs
e. Sleeves
f. Pocket
For upper garment, skirts / pants.

Unit 4 **2**

Design, develop and construct an evening gown using draping technique

Unit 5 **4**

Transformational Reconstruction (TR) technique for design and volume. (TR cutting)

ADVANCED TEXTILE AND APPAREL TESTING

FAD 3.5 **16 Practicals of 4 Hrs each**

Objectives:

- To acquaint students with procedures adopted to analyze textile fabrics and apparel for end use performance.

Unit 1 **4**

Determination of fabric tensile characteristics,tearing strength and bursting strength. Seam strength and seam slippage.

Unit 2 **6**

Testing fabrics forstiffness, drape co-efficient, abrasion resistance, pilling resistance, dimensional stability and colour fastness.

Unit 3 **3**

Testing fabrics for moisture properties: moisture management, repellence properties.

Unit 4 **1**

Flammability tests for textile fabrics.

Unit 5 **1**

Assessments of tailorability of fabrics using FAST.

Unit 6 **1**

Objective colour measurement of dyed fabrics.

APPAREL VALUE ADDITION

FAD 3.6 **16 Practicals of 4 Hrs each**

Objectives:

- To introduce and train students on value addition aspects.
- To enable students to learn methods of value addition using different techniques.

Unit 1 **2**

Introduction to value addition techniques through weaves, prints, embroidery and painting techniques

Unit 2 **4**

Develop designs using different types of weave designs, print, painting.

Unit 3 **4**

Developing samples of regional embroideries of India.

Unit 4 **2**

Appliqué, Bead work, Patch work, Cut work, drawn thread work and smocking

Unit 5 **2**

Design and development of samples using metal embroidery

Unit 6 **1**

Dyeing: Tie and dye, Batik, Shibori and their types.

Unit 7 **1**

Market Survey for value addition and surface ornamentation samples and pricing, with respect to value addition, ornamentation and develop a folio.

FASHION ACCESSORY DESIGN AND PRODUCTION

FAD 3.7 **16 Practicals of 4 Hrs each**

Objectives:

- To impart knowledge of fashion accessory materials and handling methods.
- To familiarize students about current fashion accessory making trends.

Unit 1 **2**

Portfolio of accessory materials: Beads, stones, fabrics, threads, fasteners.

Unit 2 **3**

Sketching and rendering of belts, gloves, hats, bags and construction of any one.

Unit 3 **6**

Sketching of Indian jewellery: Mughal Jewellery, Thewa, Kundan Jewellery, Temple Jewellery and construction of contemporised design inspired by traditional Indian jewellery.

Unit 4 **2**

Sketching of accessories on women and mencroqui (2 each).

Unit 5 **3**

Designing and develop a sample using macramé, crochet, bead work technique

FASHION DESIGN

FAD 3.8 OE **No. of Teaching Hrs. 52**

Objectives:

- To impart advanced knowledge in fashion design.
- To impart knowledge about designing for special categories.

Unit 1 **2 Hrs**

Design Concepts: Elements and principles of design, application of design concepts in fabrics and fashion products.

Unit 2 **6Hrs**

Couture: Meaning and place in the fashion industry, organization, controlling bodies,International couture, decline and revival of couture, characteristics and specialties.

Unit 3 **6Hrs**

Ready-to-wear: Definition, origin, evolution of utility clothing, design process,manufacturing techniques, work rooms and studios, factors in the growth of the industry,contribution of various cultures to ready-to-wear industry.

Unit 4 **6Hrs**

Mass Production: Process, production, sizing, design strategies, lines within a designhouse, offshore production and new trends.

Unit 5 **6Hrs**

Designing of apparels for specialty shows: Introduction, need for specialty shows,different categories- Fashion shows, trade shows, collection shows.

Unit 6 **6Hrs**

Designing for special categories: Infants, maternity, plus-size, old-age, physically challenged.

Unit 7 **8Hrs**

Designing of intimate apparels: Evolution of styles from antiquity to modern, fibers,fabrics&accessories used, types of intimate apparels, relationship between intimateapparel designs and ready-to-wear designs.

Unit8 **6Hrs**

Designing with leather and fur :Materials, production procedures- processing, finishingand apparel production, styles, laws and regulations, marketing and scope.

Unit 9 **6Hrs**

Home fashions: Evolution of designs in home fashions, Categories of home furnishingproducts - upholstery, table, bed and bath linen, styles, licensing and retailing of homefashions.

References:

1. Frances LetoZangrillo, “Fashion Design for the Plus-size”, Fairchild Publication, 1999.
2. Gavin Wadddell, “How Fashion works”, Blackwell Publishing, 2005.

3. Jay Diamond, Ellen Diamond, “The World of Fashion”, Fairchild Publication, 3rd Edition, 2002.
4. Laver, James, “Costumes & Fashions: A concise history”, Thames & Hudson, 1982.
5. Rubin LG, “The World of Fashion”, Canfield press, 1976.

SEMESTER IV

FUNCTIONAL TEXTILES & CLOTHING

FAD 4.1 **No. of Teaching Hours: 52**

Objectives:

- To introduce students to functional aspects of textiles.
- To impart knowledge on manufacture and end use applications of functional clothing and textiles.

Unit 1 **4 Hrs**

Functional Textiles: Market overview, need for functions, properties of textiles for specific functions, global and regional trends in functional textile production, world market trends.

Unit 2 **6 Hrs**

Functional fibres: Introduction, high performance fibers and specialityfibres – classification and important applications. Functional yarns - Introduction, staple and filament yarns.
Functional fabric structures – criteria to select fabric structures for various functional fabrics.

Unit 3 **6 Hrs**

Surface modification for improved functionality: Introduction, types of surface modification, physical and chemical characterization of surface modifications, applications for functional textiles, future trends.

Unit 4 **6 Hrs**

Medical textiles: Introduction, biomaterials for medical textiles, implantable, non implantable, extra corporal, healthcare and hygiene applications of textiles.

Unit 5 **4 Hrs**

Protective textiles: Introduction, thermal, chemical and ballistic protection and their application.

Unit 6 **6 Hrs**

Defense textiles and textile reinforced composites: Military textile materials, water proof breathable, water vapour permeable fabrics, military combat clothing systems, camouflage clothing, composite materials, and applications of textile composites.

Unit 7 **4 Hrs**

Build textiles: Introduction to construction textiles, advanced thermal insulation, two dimensional & three dimensional fibre textile composites, selection and property analysis of fibers and structures.

Unit 8 **6 Hrs**

Nano textiles: Nano science and technology.
Carbon nanotubes and nano applications in textiles and their importance in textile industry.

Unit 9 **6 Hrs**

Smart textiles: Interaction design in smart clothing, specific requirements and applications of sensors, actuators, data processing, storage and communication in intelligent textile assembly, phase change materials, stimuli sensitive materials applications in textiles, wearable electronics and applications.

Unit 10 **4 Hrs**

Eco-functional textiles: Introduction to eco-friendly textile materials-green composites.

References:

1. Amar K. Mohanty, Manjusri, Lawrence T, "Natural Fibers, Biopolymers and biocomposites" Boca Raton, London, 2005.
2. Anand S.C., Kennedy J.F. Miraftab M. and Rajendran S., "Medical Textiles and Biomaterials for Health care", Wood Head Publishing Ltd. England, 2006.
3. Horrocks, A.R, Anand, S.C "Handbook of Technical Textiles", Wood Head Publishing Ltd., 2000.
4. HVJ, "Shape Memory Polymers and textiles", Wood Head Publishing limited, England, 2007.
5. Xiaoming Tao, "Wearable Electronics and Photonics", The Textile Institute, CRC press, Manchester, 2005.

FASHION JOURNALISM AND PHOTOGRAPHY

FAD 4.2 **No. of Teaching Hrs. 52**

Objectives:

- To develop creative fashion photographic approaches among students for thematic fashion article presentation and interpretations.
- To educate fashion journalism methods and currents trends of photography methods and equipments.

Unit 1 **6 Hrs**

Fashion Journalism: History, introduction, elements of fashion journalism, scope of fashion journalism in current fashion world, fashion writers, writing and editing articles, published fashion media, formulation and styling of fashion shoot, fashion critics and fashion reports.

Unit 2 **8 Hrs**

Fashion journalists: Types, researching of fashion trends and conducting interviews, working methods, information gathering methods, tools and techniques used to gather information, reporting styles.

Unit 3 **4 Hrs**

Introduction to fashion journalism media: Fashion magazines, books, lifestyle sections of newspapers, television, online fashion magazines, websites, blogs, and social networks.

Unit 4 **6 Hrs**

Public relationship management: Cordial relationships with fashion industry people-fashion photographers, designers, celebs, models and public relation specialists.

Unit 5 **8 Hrs**

Fashion photography: Types of photography, criteria for selecting camera and lens, working principles of professional cameras and accessories.

Photography techniques and equipment for different fields: Modelling, newspaper, magazines, Occasions: Fashion Shows, fashion fairs.

Unit 6 **6 Hrs**

Lighting techniques: Need, methods, lighting ratio and the effects of soft high key, glamour shots, mood shots, styling and makeup for fashion and glamour photography.

Unit 7 **8 Hrs**

Indoor and Outdoor Photography:Camera, lens and equipment selection, lighting techniques - shooting with natural light, methods used to modify lighting on location, half and full length shots, comparison of Outdoor Photography by with Indoor photography.

Unit 8 **6 Hrs**

Fashion photography trends**:** Photography using digital cameras video photography, image mixing, application of computers in photography- image collage methods, cloning techniques, printing techniques.

References

1. Billy Pegram, "Fashion Model Photography: Professional Techniques and Images", Amherst Media, 1999.
2. Bruce Smith, "Fashion Photography: A Complete Guide to the Tools and Techniques of the Trade", Amphoto Books, Watson Guptill Publication, New York, 2008.
3. John Hedgecoe, "The Book of Photography", DK Publishing Inc., United States, 2005.
4. Julie Bradford."Fashion Journalism" Routledge, 2014.
5. Stephen A Dantzig," Lighting Techniques for Fashion and Glamour Photography", Amherst Media, Inc, New York, 2005.

MANAGEMENT INFORMATION SYSTEMS

FAD 4.3 **No. of Teaching Hrs. 52**

Objectives:

- To equip students with essential knowledge of computers and Management Information system.
- To acquaint students with emerging trends in MIS.

Unit 1 **8 hrs**

Management Information Systems - Need, Purpose and Objectives.Contemporary Approaches to MIS - Information as a strategic resource - Use of information for competitive advantage - MIS as an instrument for the organizational change

Unit 2 **8 hrs**

Information, Management and Decision Making, Models of Decision Making - Classical, Administrative and Herbert Simon's Models, Attributes of information and its relevance to Decision Making - Types of information

Unit 3 **6 hrs**

Information Technology - Definition, IT Capabilities and their organizational impact. Telecommunication and Networks - Types and Topologies of Networks, IT enabled services such as Call Centers, Geographical Information Systems etc.

Unit 4 **6 hrs**

Data Base Management Systems - Data Warehousing and Data Mining

Unit 5 **4hrs**

Systems Analysis and Design - Systems Development Life Cycle, Alternative System Building Approaches .

Unit 6. **8 hrs**

Decision Support Systems - Group Decision Support Systems, Executive Information Systems - Executive Support Systems - Expert Systems and Knowledge Based Expert Systems, Artificial Intelligence

Unit 7 **8 hrs**

Management Issues in MIS - Information Security and Control, Quality Assurance, Ethical and Social Dimensions, Intellectual Property Rights as related to IT Services / IT Products - Managing Global Information Systems

Unit 8. **4hrs**

Applications of MIS in apparel industry, Role of information systems in SCM and CRM.

.

References:

1. Davis and Olson. Management Information Systems, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2nd Edition 2000.
2. Jawadekar, W.S., Management Information Systems, , Tata McGraw Hill, 1997.
3. Kenneth C Laudon, Jane P Laudon, Management Information Systems- Managing the digital firm, 7th Ed., Prentice Hall, India 2002.
4. Robert Schultheis, Mary Sumner, Management Information Systems, Tata McGraw Hill, 2008
5. Sadagopan,S. Management Information Systems, PHI Learning Pvt. Ltd, 1997.

EXPORT TRADE AND DOCUMENTATION

FAD 4.4 **No. of Teaching Hrs. 52**

Objectives:

- To acquaint students with the nature and scope export trade.
- To familiarize students with the documents involved in foreign trade &processing of an export order.

Unit 1 **4Hrs**

Introduction to export trade: Nature and scope of export trade, factors influencing export trade, benefits and problems in international trade.

Unit 2 **6 Hrs**

Organizations: Principles of formation, forms of business, proprietorship, partnership, and public / private limited company.

Unit 3 **6Hrs**

Export firm: Nature of export firm, setting up of an export firm, export licensing, registration formalities - registrations with RBI, EPC, DGFT, commodity boards, income tax and customs authorities.

Unit 4 **6Hrs**

Export promotional measures: Role of export promotional councils, commodity boards, ECGC, role of commercial banks, establishment & significance of SEZ & EPZ, availing concessions and incentives under various export promotion schemes, duty drawback, subsidies.

Unit 5 **4 Hrs**

Trade blocs: Effects of trade blocs on world trade, major trade blocs – EU, ASEAN and NAFTA.

Unit 6 **4 Hrs**

Export order execution: Steps in export procedure, risks involved in documentation procedure, customs clearance.

Unit 7 **6 Hrs**

Letter of credit: Definition and processing of letter of credit, principles and types of letter of credit, checklist, advantages and disadvantages of letter of credit.

Unit 8 **4 Hrs**

Export documents:Principal& auxiliary documents, steps involved in availing export documents.

Unit 9 **4 Hrs**

Export payments: Pre-shipment and post shipment finances, negotiation of documents.

Unit 10 **4 Hrs**

Export risk management, export barriers- tariff and non tariff barriers.

Unit 11 **4 Hrs**

Foreign exchange market, EXIM policies, FEMA and FERA.

References

1. Donnellan, John, "Merchandise Buying and Management", Fairchild Books, 3rd Edition, 2007.
2. Jain, R.K. "CUSTOMS TARIFF of India 2013-14", 55th Edition, 2013.
3. Jain, R.K. "Foreign Trade Policy & Handbook of Procedures with Forms, Circulars & Public Notices (Vol.1) 2009-2014" 19th Edition, 2013.
4. Sandeep M. Bhatnagar, " Export Oriented Units - Law and Procedures", 14th Edition, 2013.
5. Thomas E. Johnson and Donna L. Bade, "Export/Import -Procedures and Documentation" Amacom, 4th Edition, 2010.
6. Warren J. Keegan, "Global Marketing", Prentice Hall PTR, 7th Edition, 2012.

FASHION STUDIO

FAD 4.5 **16 Practicals of 4 Hrs each**

Objectives:

- To acquaint students with creative writing skills in fashion.
- To enable students to gain first hand knowledge in visual merchandising.

Unit 1 **1**

Development of writing skills using 5Ws and 1H in creative fashion writing.

Unit 2 **3**

Fashion Journalism: Review of fashion columns and photographs from magazines, newspapers and periodical content from historical and modern sources. Design an article using the above on current fashion trends

Unit 3 **4**

Photo Journalism: Use of cartoons, pictures and comic strips to creating brand logo, Labels and fashion communication tools-brochures, pamphlets, handouts and other promotional tools.

Unit 4 **3**

Use of photographic tools and softwares to create fashion communication brochures, pamphlets, handouts and other promotional tools (Theme based).

Unit 5 **2**

Development of logos and fashion labels based on theme.

Unit 6 **3**

Visual merchandising: Use of visual merchandising tools, create theme based display for sales promotion for the designed product from apparel, jewellery, accessory or home interior products.

BANGALORE UNIVERSITY
DEPARTMENT OF STATISTICS

MSc COURSE
in
STATISTICS

REGULATIONS AND SYLLABUS

SEMESTER SCHEME
(CBCS)
Year 2017

JNANA BHARATHI
BENGALURU 560 056

FIRST SEMESTER

STA 101: SAMPLING THEORY

(52 hours : 4 credits)

Unit 1

Standard random sampling methods: Simple random sampling, stratified random sampling, and systematic sampling. Determination of sample size. Determination of number of strata, construction of strata, post stratification. Design of field surveys. Questionnaire designing. Interviewing. Preparation of reports

10 hrs

Unit 2

Unequal probability sampling: Probability proportional to size (PPS) with replacement: Cumulative total method and Lahiri's scheme. Hansen-Hurwitz estimator. PPS without replacement: Horvitz-Thompson estimator, Midzuno-Sen estimator, Des Raj estimator for a general sample size and Murthy's estimator for a sample of size 2.

14 hrs

Unit 3

Cluster sampling with equal and unequal cluster sizes. Two-stage sampling with equal number of second stage units. SRS at both the stages. Two-stage sampling with unequal number of second stage units.

10 hrs

Unit 4

Ratio and regression estimators based on SRSWOR sampling: Bias, mean squared error, and variance estimation. Double sampling for ratio and regression estimation.

8 hrs

Unit 5

Issues in small area estimation - direct and synthetic estimators. Errors in surveys. Non-sampling errors. Randomized responses for variables: Warner and Greenberg models. Modeling observational errors, estimation of variance components, applications to longitudinal studies, repetitive surveys.

10 hrs

References

1. Chaudhuri, A. and Mukherjee, R. (1988). *Randomized Response: Theory and Techniques*, Marcel Dekker, New York.
2. Cochran, W. G. (1977). *Sampling Techniques*, 3/e; John Wiley, New York.
3. Des Raj and Chandok, P. (1998). *Sample Survey Theory*, Narosa Publishing House, New Delhi.
4. Mukhupadhyay, P. (2009). *Theory and Methods of Survey Sampling*, 2/e, Prentice Hall, New Delhi.
5. Murthy, M. N. (1977). *Sampling Theory and Methods*, Statistical Publishing Society, Calcutta.

6. Sampath, S. (2006). *Sampling Theory and Methods*, 2/e, Narosa Publishing House, New Delhi.

7. Singh, D. and Chaudhary, F.S. (1986). *Theory and Analysis of Sample Survey Designs,* New Age International Publishers, New Delhi.

8. Sukhatme et al. (1984). *Sampling Theory of Surveys with Applications,* Iowa State University Press, USA.

STA 102: PROBABILITY THEORY – I

(52 hours : 4 credits)

Unit 1

Classes of sets: Field, σ -field, minimal σ-field, Borel field on R and R^n. Sequences of sets and their limits. Measure and its properties - σ-finite mesure. Counting measure. Lebesgue and Lebesgue- Stieltjes measures. Probability measure and its properties. **10 hrs**

Unit 2

Random variables, algebra of random variables, sequences of random variables, and vector random variables. Probability measure induced by a random variable. Distribution function of a random variable (d.f.), its properties. Decomposition of a d.f. into discrete and continuous parts. **12 hrs**

Unit 3

Expectation of a random variable. Properties. Monotone convergence theorem. Statement of dominated convergence theorem. Markov, Chebycheff, Jensen, Minkowski, and Holder inequalities. **12 hrs**

Unit 4

Characteristic function. Properties. Inversion theorem and its applications. Uniqueness theorem.

8 hrs

Unit 5

Product measure space. Fubini's theorem. Fatou's lemma, Statement of Radon-Nikodym theorem and its applications. **10 hrs**

References

1. Ash, R.B. and Doleans-Dade, C.A. (2000). *Probability and Measure Theory*, Academic Press, New York.

2. Bhat, B.R. (1999). *Modern Probability Theory,* 2/e, New Age International, New Delhi.

3. Billingsley, P. (1995). *Probability and Measure*, 3/e, John Wiley, New York.

4. Burril, C. (1972). *Measure, Integration, and Probability,* McGrawHill International, New York.

5. Chung, K.L.(2001). *A Course in Probability, 3/e,* Academic Press, New York.

6. Clarke, L.E. (1975). Random Variables, Longman Mathematical Texts, London.

7. Khosnevisan, D. (2013). *Probability*, American Mathematical Society, Indian Edition, Universities Press, Hyderabad.

8. Rao, C.R. (1973). *Linear Statistical Inference and Its Applications*, John Wiley, New York.

STA 103: DISTRIBUTION THEORY – I

(52 hours : 4 credits)

Unit 1

Distribution function of a random variable. Moment generating function. Probability generating function. **6 hrs**

Unit 2

Standard discrete and continuous distributions: Discrete uniform, binomial, Poisson, geometric, negative binomial, hyper geometric, uniform, normal. lognormal, exponential, gamma, beta, Weibull, Laplace, Pareto, Chisquare, t, and F distributions. Non-central chi-square, t, and F distributions. **12 hrs**

Unit 3

Truncated, power series, modified power series, compound, and mixture distributions. Distributions of functions of random variables: Transformation and moment generating function techniques. **12 hrs**

Unit 4

Distribution function of a random vector. Joint, marginal, and conditional distributions. Conditional expectation and conditional variance. Distributions of functions of several random variables - change of variables technique. Convolution of two random variables. **12 hrs**

Unit 5

Bivariate Normal Distribution: Marginal and conditional distributions, moment generating function. Bivariate exponential distribution: Gumbel and Marshall-Olkin. **10 hrs**

References

1. Dudewicz, E. J. and Mishra, S. N. (1980). *Modern Mathematical Statistics*, John Wiley, New York.

2. Hogg, R.V. and Tanis, E.A. (2005). *Probability and Statistical Inference*, 6/e, Macmillan, New York.

3. Johnson, N. L. and Kotz, S., and Balakrishnan, N. (1994). *Continuous Univariate Distributions*, Vol. 1 and Vol. 2, Wiley, New York.

4. Mukhopadhyay, P. (2015). *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.
5. Rohatgi, V.K. and Saleh, A.K.Md. E. (2002). *An introduction to Probability and Statistics,* John Wiley, New York.
6. Rao, C.R. (1973). *Linear Statistical Inference and Its Applications,* Wiley Eastern, New Delhi.

STA 104: QUALITY ASSURANCE AND RELIABILITY ANALYSIS

(52 hours : 4 credits)

Unit 1

Concept of quality. Quality function and quality characteristics. Statistical modeling. Quality assurance - its evolution and modern trends. Statistically controlled processes. Chance and assignable causes. Principles of a process control chart and associated decision rules. Shewhart control charts for monitoring process level and process dispersion. Rational subgroups. Pre-control and analysis of patterns on a control chart. The seven QC tools. Design quality and conformance quality. Quality costs. Quality and productivity. Design and implementation of SPC and six-sigma programmes. BIS and ISO certification.

10 hrs

Unit 2

Analysis of OC, ARL, and other measures. Techniques for improving sensitivity of a chart. Natural tolerances. Process capability and its measures. CUSUM and EWMA charts. Process control with autocorrelated observations. Modifications of Shewhart control chart. Multivariate control charts.

10 hrs

Unit 3

Single and double lot-by-lot acceptance sampling plans. Performance analysis of sampling plans: OC, ASN, AOQ, and AOQL. Dodge-Romig and MIL-STD systems.

6 hrs

Unit 4

Reliability and hazard rate functions of a single component. Classes of lifetime distributions. Concept of ageing, positive and negative ageing, IFR, IFRA, NBU, NBUE, DMRL classes of distributions and their dual classes. Interrelations among the classes of life time distributions. Closures of these classes under formation of coherent systems, convolutions, and mixtures. Series and parallel systems. k-out- of -n system. Structure function and block diagrams of these systems. Minimal path and minimal cut sets.

12 hrs

Unit 5

Reliability of systems of independent components. Bounds of reliability functions of these systems. System life as a function of component lives. Expected system lifetime. Systems with repairs. Maintenance policies: Age replacement and block replacement policies and their characteristics. Reliability modeling: Introduction to shock models, stress-strength models, and proportional hazard models. **14 hrs**

References

1. Alwan, L.C. (2000). *Statistical Process Analysis,* McGraw Hill, New York.
2. Barlow, R.E. and Proschan, F. (1981). *Statistical Theory of Reliability and Life Testing,* 2/e, To Begin With, Silver Spring, MD, USA.
3. Burr, ????
4. Grant, E. L. and Leavenworth, R. S. (1996). *Statistical Quality Control*. 7th edition, McGrawHill, New York.
5. Mittage, H.J. and Rinne, H. (1993). *Statistical Methods of Quality Assurance,* Chapman and Hall, London, UK.
6. Montgomery, D.C. (2012). *Introduction to Statistical Quality Control*, 7/e, John Wiley, New York.
7. Ross, S.M. (2010). *Introduction to Probability Models,* 10/e, Academic Press, New York.
8. Smith, G.M. (1991). *Statistical Process Control and Quality Improvement*, 3/e, Prentice Hall, New York.
9. Wetherill, G.B. and Brown, D.W. (1991). *Statistical Process Control: Theory and Practice,* Chapman and Hall, London, UK.

STA 105: REAL ANALYSIS

(52 hours : 4 credits)

Unit 1

Interior points and limit points of subsets of R. Open and closed subsets of R. Bolzanao-Weierstrass theorem.

6 hrs

Unit 2

Riemann-Stieltjes (R-S) integral of a bounded real valued function. Necessary and sufficient condition for R-S integrability. Properties of R-S integrals. Integration by parts. Change of variables in R-S integrals. Mean value theorems for R-S integrals.

15 hrs

Unit 3

Improper Riemann and Riemann -Stieltjes integrals. Convergence and absolute convergence of improper integrals. Abel's and Dirichlet's theorems on the convergence of the integrals of the product of two integrands. Beta and Gamma integrals and their properties. Legendre's duplication formula. Stirling's approximation for n! Integrals involving parameters. Improper integrals involving parameters and their uniform convergence. Differentiation under the integral sign.

12 hrs

Unit 4

Maxima and minima of functions of several variables. Lagrangian multipliers. Double integrals. Leibnitz rule.

9 hrs

Unit 5

Sequences and series of functions. Pointwise and uniform convergence. Weierstrass test. Consequences of uniform convergence of sequences and series of functions Term by term integration and differentiation **10 hrs**

References

1. Apostol, T.M. (1986). *Mathematical Analysis*, 2/e, Narosa Publishing House, New Delhi.
2. Bartle, R.G. (1975). *The Elements of Real Analysis*, 2/e, John Wiley.
3. Bilodeau, G.G., Thie, P.R., and Keough, G.E. (2010). *An Introduction to Analysis*, 2/e, Jones and Bartlett (Indian Edition), New Delhi.
4. Goldberg, R.R. (1970). *Methods of Real Analysis*, Oxford and IBH Publishing Company, New Delhi.
5. Malik, S.C. and Arora, S. (1998). *Mathematical Analysis*, New Age, New Delhi.
6. Rudin, W. (2013). Principles of Mathematical Analysis, 3/e, Indian Print, Tata McGrawhill, New Delhi.

STA 106: MATRIX ALGEBRA (SOFT CORE)

(40 hours : 2 credits)

Unit 1

Vector spaces, subspaces, linear dependence and independence, basis and dimension of a vector space, inner product and orthogonallity of vectors, orthonormal basis, orthogonal matrix and its properties. column and row null spaces of a matrix, nullity of a matrix. Linear transformations, non-singular and orthogonal linear transformations and their properties. Trace of a matrix: definition, properties, idempotent matrix and its properties, Partitioned matrices: computation of determinant and inverse.

10 hrs

Unit 2

Characteristic roots, characteristic vectors. Cayley-Hamilton theorem, algebraic and geometric multiplicities of a characteristic root and their relationship, similar matrices, symmetric matrices and properties of their characteristic roots and characteristic vectors, spectral decomposition of a real symmetric matrix.

8 hrs

Unit 3

Matrix decomposition: Spectral decomposition, LU decomposition, SVD, Gram-Schmidt orthogonalization process.

6hrs

Unit 4

Quadratic forms: Congruent transformations, congruence of symmetric matrices. Canonical reduction and orthogonal reduction of real quadratic forms. Sylvester's law of inertia, nature of a quadratic form, necessary and sufficient condition for a real quadratic form to

be positive definite, Gram matrix and properties, simultaneous reduction of a pair of quadratic forms. Derivative of a function with respect to a vector and a matrix.

10 hrs

Unit 5

Generalised inverse of a matrix: g-inverse and Moore – Penrose inverse: properties and computations. Systems of linear equations: consistency, existence of solutions, number of solutions, and solving the system of equations.

6 hrs

References

1. Graybill, F. A. (2002). *Matrices and Applications in Statistics*, 2/e, Wadsworth Publishing Co., Belmont, California, USA.
2. Rao, A. R. and Bhimasankaram, P. (2000). *Linear Algebra*, Hindustan Book Agency, New Delhi.
3. Searle, S. R. (2017). *Matrix Algebra Useful for Statistics*, 2/e, Wiley, New York.
4. Narayan, S. (2010). *A Text Book of Matrices*, S. Chand and Company Ltd., New Delhi.
5. Harville (1997). *Matrix Algebra from a Statistician's Perspective*, Springer-Verlag, New York.

STA 107: Practical Paper

(4 hours/ week)

(2 credits)

Introduction to R. Data and file handling in R. Descriptive statistics. Exploratory Data Analysis (EDA). Bivariate and multivariate data: numeric and character variable. Various plots in R. Simulation in R. Fitting regression models. Graphical interface in R. Programming in R- editing functions – Functions- conditional evaluation – looping and object oriented programming in R.

List of Assignments

1. R Basics and Objects. Vectors, Matrices, data.frame, and lists. R functions and packages, datasets, and Import/Export functions.
2. Descriptive statistics for univariate (numeric) data: Measures of central tendency, EDA, and dispersion. Visualization techniques: bar-plot, histogram, box plot, and stem- and-leaf diagram.
3. Bivariate and multivariate data: Plots, correlation coefficient, and regression lines.
4. Discrete and continuous distributions – pmf and pdf plots, Sampling distributions.
5. Fitting of distributions to given data – raw programs and R functions [fitdistr for example.]

6. Simulation from discrete, continuous, and mixture distributions.
7. Illustration of limit theorems.
8. Using R functions for standard parametric statistical tests.
9. Selection of SRSWR and SRSWOR.
10. Optimization: maxima and minima of functions of one and two variables. Use of *optimize* and *optim* functions.

References

1. Dalgaard, P. (2008). *Introductory Statistics with R*, Springer, New York.
2. Horgan, J. M. (2009). *Probability with R*, John Wiley, New York.
3. Prabhanjan, N.T., Suresh, R., and Manjunath, B.G. (2016). *A Course in Statistics with R*, Wiley, New York.
4. Purohit, S. Gore, Desmukh, S. (2007). *Statistics Using R*, Narosa, New Delhi.
5. Teetor, P. (2011). R Cook book, Oreilly Media Inc., Cambridge, USA.
6. Venebles, W. N. and Smith, D. M. and the R Core Development Team (2013). *An Introduction to R*, Available in Installed R Software.
7. Verzani, J. (2005). *Using R for Introductory Statistics*, Chapman and Hall, London.

STA 108: Practical Paper

(Assignments based on STA 101 and STA 104)

(4 hours/ Week)

(2 credits)

List of Assignments

1. Fitting discrete distributions and normal distribution
2. Ratio and regression methods of estimation
3. Cluster sampling
4. PPSWR
5. PPSWOR
6. Two stage sampling and double sampling methods
7. OC and ARL curves of $\overline{X}$ and R control charts
8. CUSUM control charts
9. EWMA control charts
10. Multivariate control charts
11. Single and double attribute sampling plans.

SECOND SEMESTER

STA 201: STATISTICAL INFERENCE – I

(52 hours : 4 credits)

Unit 1

Families of distributions: Location, scale, location-scale, exponential, Pitman, regular, and Cramer families**.**

4 hrs

Unit 2

Sufficiency and completeness: Sufficiency, factorization theorem, minimal sufficiency, likelihood equivalence, completeness, bounded completeness. Reparametrization, statement of the theorem on complete sufficient statistic in k-parameter exponential family.

12 hrs

Unit 3

Unbiased estimation, combining unbiased estimators. Mean square error. Fisher information function. Cramer-Rao inequality, Rao-Blackwell, and Lehmann-Scheffe theorems. Uniformly minimum variance unbiased (UMVU) estimation. Fisher information matrix, simultaneous estimation of parameters of multinomial and normal distributions. Ancillary statistics, Basu's theorem, and its application in UMVU estimation.

14 hrs

Unit 4

Methods of estimation: Maximum likelihood (ML) and moment estimation. Properties of ML estimators. Computation of ML estimates using Newton-Raphson, method of scoring, and EM-algorithm.

8 hrs

Unit 5

Testing of hypotheses: Randomized and non-randomized tests. Power and size of a test. Most powerful (MP) test. Neyman–Pearson lemma. Uniformly most powerful (UMP) tests, Monotone likelihood ratio (MLR) property and construction of UMP tests for the families of distributions possessing MLR property and applications. Non- existence of UMP tests for two-sided alternatives.

14 hrs

References

1. Casella, G. and Berger, R.L. (2002). *Statistical Inference, 2/e,* Duxbury Press, Belmont, California, USA.
2. Dudewicz, E.J. and Mishra, S.N. (1980). *Modern Mathematical Statistics*, John Wiley, New York.
3. Kale, B.K. and Muralidharan, K. (2015). *Parametric Inference: An Introduction*, Narosa, New Delhi.
4. Lehmann, E.L. and Casella, G. (1998). *Theory of Point Estimation*, Springer, New York.

5. Lehmann, E.L. and Romano, J.P. (2005). *Testing Statistical Hypotheses,* 2/e, John Wiley, New York.
6. Rohatgi, V.K.and Saleh, A.K.Md.E. (2002): *An Introduction to Probability and Statistics*, John Wiley, New York.
7. Zacks, S. (1981). *Parametric Statistical Inference*, John Wiley, New York.

STA 202: PROBABILITY THEORY – II

(52 hours : 4 credits)

Unit 1

Independence of events and of random variables. Borel-Cantelli lemma. Convergence of sequences of random variables in distribution and in probability. Almost sure convergence and convergence in the r^{th} mean Relationship between these modes of convergence. Slutsky's theorem. **14 hrs**

Unit 2

Levy's continuity thorem. Khintchin and Tchebycheff weak laws of large numbers (WLLN). Markov's condition for WLLN. Generalized WLL.N Kolmogorov's inequality. Kolmogorov strong law of large numbers (SLLN). Kolmogorov's condition for the SLLN. **12 hrs**

Unit 3

Levy, Lindeberg-Levy, and Liapunov central limit theorems. Statement of Lindeberg-Feller central limit theorem. Applications of these theorems. Delta method and its applications.

12 hrs

Unit 4

Conditional probability – properties, Conditional Expectation. Smoothing and other properties. **4 hrs**

Unit 5

Martingales. Sub and super martingales. Doob decomposition. Martingale convergence thorem. Stopping times. Doob's optional sampling theorem. Wald's fundamental identity.

10 hrs

References

1. Ash, R.B. and Doleans-Dade, C.A. (2000). Probability and Measure Theory, Academic Press, New York.
2. Bhat, B.R. (1999). Modern Probability Theory, 2/e, New Age International Publishers, New Delhi.
3. Bhat, B.R. (2000). *Stochastic Models: Analysis and Applications*, New Age International Publishers, New Delhi.
4. Billingsley, P. (1995). Probability and Measure, 3/e, John Wiley, New York.

5. Burril, C.W. (1972). Measure, Integration, and Probability, McGrawHill International, New York.

6. Chung, K.L.(2001). A Course in Probability, *3/e*, Academic Press, New York.

7. Laha, R.G. and Rohatgi, V.K. (1979). *Probability Theory*, John Wiley, New York.

8. Khosnevisan, D. (2013). *Probability*, American Mathematical Society, Indian Edition, Universities Press, Hyderabad.

9. Rao, C.R. (1973). *Linear Statistical Inference and Its Applications*, John Wiley, New York.

10. Walsh, J.B. (2010). *Knowing the Odds: An Introduction to Probability*, American Mathematical Society, Providence, Rhode Island, USA.

STA 203: DISTRIBUTION THEORY – II

(52 hours : 4 credits)

Unit 1

Multinomial and multivariate normal distributions- marginal and conditional distributions. Independence of sub vectors. Distribution of a linear function of normal random variables. **8 hrs**

Unit 2

Characteristic function of the multivariate normal distribution and its applications. Distribution of quadratic forms. Cochran's theorem. Independence of quadratic forms, independence of linear and quadratic forms. **10 hrs**

Unit 3

Sampling from Multivariate Normal Distribution – sample mean vector, sample covariance matrix. Distribution of the sample mean vector, independence of sample mean vector and sample covariance matrix. Assessing multivariate normality. Q-Q and chi-square plots. multiple and Partial Correlation coefficients and their distributions(statements only). Distribution of Hotelling's T^2 and Mahalanobis' D^2 statistics. Wishart Distribution and Distribution of sample generalized variance. **16 hrs**

Unit 4

Order statistics. Distribution of functions of order statistics. Distributions of range and sample median. Extreme value distribution. Record values.

8 hrs

Unit 5

Simulation: Design of simulation models, Technique for generating random deviates- inverse transformation method, rejection technique, Box- Muller technique for generating normal deviates. Generation of observations from multivariate normal distributions. Variance reduction technique. Statistical analysis of simulation output.

10 hrs

References

1. Anderson, T.W. (2003). *An Introduction to Multivariate Statistical Analysis,* 3/e, John Wiley, New York.
2. Arnold, B. C., Balakrishnan, N., and Nagaraja, H.N. (1992). *A First Course in Order Statistics*, John Wiley, New York.
3. Dudewicz, E. J. and Mishra, S. N. (1980). *Modern Mathematical Statistics*, John Wiley, New York.
4. Rao, C.R. (1973). *Linear Statistical Inference and Its Applications,* Wiley Eastern, New Delhi.
5. Mukhopadhyay, P. (2015). *Mathematical Statistics*, Books and Allied (P) Ltd., Kolkata.
6. Rohatgi, V.K. and Saleh, A.K.Md.E. (2002). *An introduction to Probability and Statistics,* John Wiley, New York.
7. Kshirsagar,A.M. (1972). *Multivariate Analysis,* Marcel-Dekker, New York.
8. Hogg, R.V. and Tanis, E.A.(1983). *Probability and Statistical Inference*, 3/e, Macmillan, New York.

STA 204: LINEAR MODELS AND REGRESSION ANALYSIS

(52 hours : 4 credits)

Unit 1

Linear estimation: Gauss-Markov model, least squares estimation, BLUE, Gauss-Markov theorem. Distributional properties of least squares estimators, confidence intervals, general linear hypotheses, testable hypotheses, and their likelihood ratio test procedure. Estimation under linear restrictions involving estimable functions. **14 hrs**

Unit 2

Multiple linear regression, estimation, and porperties. Prediction of new observations and prediction interval. Hidden extrapolation. Use of dummy variables. Generalized linear models: link function, binary logistic regression, and Poisson regression. **12 hrs**

Unit 3

Measures of model adequacy, coefficient of determination R^2, lack of fit test, residuals, scaling residuals, and residual analysis: residual plots as tests for departure from assumptions of homoscedasticity, normality (Q-Q plot), non-linearity, and detection of outliers. Detecting influential observations. Transformations: Box-Cox transformation and transforming the predictors. Subset selection of regressors: Mallow's C_p statistic, all possible, stepwise, forward and backward regressions.

12 hrs

Unit 4

Heteroscedasticity and autocorrelation: sources, consequences, detection, and remedial procedures. **6 hrs**

Unit 5

Multicollinearity: sources, consequences, detection, and remedial procedures. Ridge regression and generalised least squares. Validation of regression models. Analysis of model coefficients and predicted values. Collecting fresh data. Data splitting. **8 hrs**

References

1. Cook, R. D. and Weisberg, S. (1982). *Residual and Influence in Regression,* Chapman and Hall, London,UK.
2. Draper, N. R. and Smith, H. (1998). *Applied Regression Analysis, 3/e,* John Wiley, NewYork.
3. Gunst, R. F. and Mason, R. L. (1980). *Regression Analysis and Its Applications - A Data Oriented Approach*, Marcel and Dekker, New York.
4. Montgomery, D. C. and Peck, E. A., and Vining, G. G. (2012). *Introduction to Linear Regression*, 5/e, John Wiley, New York.
5. Ryan, T. P. (1997). *Modern Regression Methods,* John Wiley, New York.
6. Searle, S. R. (1971). *Linear Models,* John Wiley, New York.
7. Weisberg, S. (1985). *Applied Linear Regression*, John Wiley, New York.

STA 205: MULTIVARIATE ANALYSIS

(52 hours : 4 credits)

Unit 1

MLE's of the parameters of multivariate normal distribution and their sampling distributions. Likelihood ratio tests: Tests of hypotheses about the mean vectors and covariance matrices for multivariate normal populations. Independence of sub vectors and sphericity test. **12 hrs**

Unit 2

Classification and discriminant procedures: Bayes, minimax, and Fisher's criteria for discrimination between two multivariate normal populations. Sample discriminant function. Tests associated with discriminant functions. Probabilities of misclassification and their estimation. Discrimination for several multivariate normal populations. Canonical discriminant function. **10 hrs**

Unit 3

Multivariate regression model: Estimation of parameters, tests of linear hypotheses about regression coefficients. Multivariate analysis of variance (MANOVA) of one and two- way classified data. **8 hrs**

Unit 4

Principal components, sample principal components asymptotic properties. Canonical variables and canonical correlations: definition, estimation, computations. Test for significance of canonical correlations. Factor analysis: Orthogonal factor model, factor loadings, estimation of factor loadings, factor scores. Applications. **12 hrs**

Unit 5

Cluster Analysis: distances and similarity measures, hierarchical clustering methods, K – means method. Multidimensional scaling: nature of the problem, classical solution.

10 hrs

References

1. Anderson, T. W. (2004). *An Introduction to Multivariate Statistical analysis,* 3/e, John Wiley, New York.
2. Giri, N. C. (1977). *Multivariate Statistical Inference,* Academic Press, New York.
3. Johnson, R. A. and Wichern, D.W. (2003). *An Introduction to Multivariate Statistical Analysis*, 5/e, Pearson Education.
4. Kshirsagar, A. M. (1972). *Multivariate Analysis,* Marcel Dekker, New York.
5. Morrison, D. F. (2005). *Multivariate Statistical Methods,* 4/e, McGrawhill, New York.
6. Muirhead, R. J. (1982). *Aspects of Multivariate Statistical Theory,* John Wiley, New York.
7. Rao, C. R. (1973). *Linear Statistical Inference and Its Applications,* 2/e, John Wiley, New York.
8. Seber, G. A. F (1984). *Multivariate Observations,* John Wiley, New York.
9. Sharma, S. (1996). *Applied Multivariate Techniques,* John Wiley, New York.
10. Srivastava, M. S. (1979). *An Introduction to Multivariate Statistics,* North Holland**.**
11. Mardia, K. V., Kent, J. T., and Bibby, J. M. (1979). *Multivariate Analysis,* Academic Press, New York.

STA 206: STATISTICS FOR NATIONAL DEVELOPMENT AND DEMOGRAPHY (SOFT CORE)

(40 hours : 2 credits)

Unit 1

Economic development: Classical growth models of Adam Smith, Malthus, David Ricardo. Growth in per capita income and distributive justice. Indices of development, human development index. **10 hrs**

Unit 2

Estimation of national income: product approach, income approach, and expenditure approach. GNP and GDP of India. **4 hrs**

Unit 3

Measuring inequality in incomes, Gini coefficient, and Theil's measure. Poverty measurement: measures of incidence and intensity, combined measures, Kakwani and Sen indices.

6 hrs

Unit 4

Measures of fertility. Distribution of time to first birth. Inter-live birth intervals and number of births (for both homogeneous and non-homogeneous groups). Estimation of parity progression ratios. Measures of mortality and cohort measures. Construction of abridged life tables. Distribution of life table functions.

12 hrs

Unit 5

Population growth models- exponential, logistic, Gompertz models. Population projection using Leslie matrix.

8 hrs

References

1. Biswas, S. (1988). *Stochastic Processes in Demography and Applications,* Wiley Easter, New Delhi.
2. Chiang, C. L. (1968). *Introduction to Stochastic Processes in Biostatistics,* John Wiley, New York.
3. Gupta, K. R. (2010). *Economic Growth Models*, Atlantic Publishers and Distributors, New Delhi.
4. Keyfitz, N. (1977). *Applied Mathematical Demography,* Springer Verlag.
5. Ramkumar, R. (1986). *Technical Demography, Wiley Eastern, New Delhi.*
6. Sen, A. (1977). *Poverty and Inequality,* Stanford University Press, USA.

STA 207: Practical Paper

(Assignments Based on STA 201 and STA 205)

(4 hours / Week)

(2 credits)

1. Generating random samples given sufficient statistics.
2. UMVU estimates.
3. MP tests.
4. UMP tests.
5 Maximum likelihood and moment estimates.
6. Maximum likelihood estimate: Method of scoring.
7. Applications of Hotelling's T^2.
8. Tests concerning covariance matrices.
9. Multivariate regression analysis and MANOVA.
10. Discriminant analysis and classification.
11. Principal component analysis and canonical correlations.
12. Factor analysis.

STA 208: Practical Paper

(Assignments Based on STA 203 and STA 204)

(4 hours / Week)

(2 credits)

1. Computation of mean vector, covariance matrix, partial and multiple correlations. from a multivariate data.
2. Test for multivariate normal distribution.
3. Simulation of observations from univariate and multivariate normal distributions.
4. Fitting multiple linear regression models.
5. Stepwise regression analysis.
6. Multicollinearity diagnostics.
7. Residual analysis.
8. Tests for autocorrelation.
9. Fitting a ridge regression model.
10. Fitting logistic and Poisson regression models.

THIRD SEMESTER

STA 301: STATISTICAL INFERENCE - II

(52 hours : 4 credits)

Unit 1

Consistency: Definition and criteria for consistency. Weak and strong consistencies. Marginal and jointly consistent estimators. Methods of obtaining consistent estimators, Invariance property. Comparison of consistent estimators. Consistent asymptotically normal (CAN) property: Definition and methods of obtaining CAN estimators. Example of consistent but not asymptotic normal in Pitman family. Invariance property. CAN property of MLE in Cramer's family. Best asymptotically normal (BAN) estimator. Asymptotic relative efficiency (ARE). **16 hrs**

Unit 2

Robust estimation: The influence curve and empirical influence curve. M-estimation: Median, Trimmed and winsorized mean. Influence curve for M-estimators. Limiting distribution of M-estimators. Resampling methods: Quenouille's Jackknife estimation, parametric and nonparametric bootstrap methods. **7 hrs**

Unit 3

Likelihood ratio (LR) test: Standard applications including one and two sample problems for the normal and exponential distributions. Role of sufficiency in LR tests, Relationship between LR test and most powerful test. Asymptotic distribution of the LR test statistic. Wald and Rao's score tests. Consistency of LR test. **10 hrs**

Unit 4

Similar tests and unbiased tests. Statements of theorems for the construction of UMPU tests for exponential families of distributions and their application to samples from normal distribution leading to t, χ^2 and F tests – one and two-sample problems. Student's t- test for correlation coefficient. **12 hrs**

Unit 5

Interval estimation: Concept of confidence level and confidence co-efficient. Duality between acceptance region of a test and a confidence interval. Pivotal quantity method. Shortest length confidence intervals. UMA and UMAU confidence intervals. Large Sample confidence regions based on CAN estimators. **7 hrs**

References

1. Casella, G. and Berger, R. L. (1990). *Statistical Inference*, 2/e, Duxbury Press, Belmont, California, USA.
2. Dudewicz, E. J. and Mishra, S. N. (1980). *Modern Mathematical Statistics*, John Wiley, New York.

3. Kale, B. K. and Muralidharan, K. (2015). *Parametric Inference: An Introduction,* Narosa, New Delhi.
4. Lehmann, E. L. and Cassella, G. (1998). *Theory of Point Estimation,* 2/e, Springer-Verlag, New York.
5. Rohatgi, V. K. and Saleh, A. K. Md. E. (2002). *An Introduction to Probability and Statistics,* 2/e, John Wiley, New York.
6. Zacks, S. (1981). *Parametric Statistical Inference,* John Wiley, New York.

STA 302: DATA MINING AND MACHINE LEARNING

(52 hours : 4 credits)

Unit 1

Essential Machine Learning: Empirical Probabilities, apriori algorithm, naïve Bayes, graphical models, simulation, SMOTE, interest measures, ROC tests, k-fold cross-validation, regularization and bias-variance tradeoff, and EM algorithm. **10 hrs**

Unit 2

Neural Networks: Neural network (NN) architecture, activation functions, single layer perceptron model, multi-layer NN, back-propagation algorithm, and convolutional NN. **8 hrs**

Unit 3

CART: Constructing a tree, regression, classification, and survival tree, pruning trees, trees for imbalanced data, bagging, random forests, and boosting techniques. **10 hrs|**

Unit 4

Support Vector Machine: Kernel based regression, SVM and discriminant analysis, Gaussian kernel based SVM, and SVM regression. **7 hrs**

Unit 5

High Dimensional Data and Unsupervised Learning: Least absolute squares selection operator (LASSO), least angle regression (LARS), smoothly clipped absolute deviation, and high-dimensional inequalities. Unsupervised learning: k-means, k-mediods, hierarchical clustering, principal component analysis (PCA), and high-dimensional PCA. **17 hrs**

References

1. Alpaydin, E. (2014). *Introduction to Machine Learning*, 3e., MIT Press, USA.
2. Bishop, C. (2007). *Pattern Recognition and Machine Learning,* Springer, New York.
3. Breiman, L., Friedman, J., Stone, C. J., and Olshen, R. A. (1984). *Classification and Regression Trees*. CRC Press, London.

4. Bühlmann, P., and Van De Geer, S. (2011). *Statistics for High-dimensional Data: Methods, Theory, and Applications*, Springer Science and Business Media, USA.
5. Efron, B, and Hastie, T. (2016). *Computer Age Statistical Inference*, Cambridge University Press, London.
6. Hastie, T., Tibshirani, R. and Friedman, J. (2009). *The Elements of Statistical Learning*, 2/e, Springer, New York, USA.
7. Haykin, S. (2009). *Neural Networks and Learning Machines*, Pearson, New Delhi.
8. Mitchel, T. M. (2013). *Machine Learning*, McGraw Hill, New York, USA.
9. Tattar, P. N. (2013). *R Statistical Application Development by Example Beginner's Guide*. Packt Publishing Ltd.

STA 303: STOCHASTIC PROCESSES

(52 hours : 4 credits)

Unit 1

Stochastic processes and their classification according to state space and time domain. Countable state space Markov chains. Chapman-Kolmogorov equations, n-step transition probabilities and first passage probabilities. Computing n-step transition probability matrix by spectral representation.

12 hrs

Unit 2

Classification of states and chains. Invariant distributions. Estimation of transition probabilities of a Markov chain. Absorption probabilities. Absorption and recurrence times. Random walk. Applications from social, biological and physical sciences.

10 hrs

Unit 3

Continuous time Markov processes. Kolmogorov-Feller differential equations. Poisson process. Pure birth process, Yule-Furry process. Birth and death process. Applications to queuing theory.

12 hrs

Unit 4

Renewal process, renewal function. Renewal equation. Elementary renewal theorem and its applications.

8 hrs

Unit 5

Galton - Watson branching processes. Properties of generating functions. Offspring mean and classification of Galton – Watson Processes. Probability of extinction.

10 hrs

References

1. Adke, S. R. and Manjunath, S. M. (1984). *An Introduction to Finite Markov Processes*, Wiley Eastern. New Delhi.
2. Issacson,D. L, and Madsen, R. W. (1976). *Markov Chains and Applications*, John Wiley, New York.
3. Karlin, S and Taylor, H. M. (1975). *A First Course in Stochastic Processes*, Academic Press, New York.
4. Bhat, B. R. (2000). *Stochastic Models*, New Age International, New Delhi.
5. Medhi, J. (2017). *Stochastic Processes*, 4/e. New Age International, New Delhi.
6. Ross, S.M. (1996). *Stochastic Processes*, 2/e, John Wiley, New York.
7. Hoel, P.G., Port, S.C., and Stone, C.J. (1991). *Introduction to Stochastic Processes*, Universal Book Stall, New Delhi.
8. Jones, P.W. and Smith, P. (2001). *Stochastic Processes: An Introduction*, Arnold Press, New York.

STA 306: Practical Paper

(Assignments based on STA 301 and STA 303)

(4 hours / Week)

(2 credits)

1. Computing n-step transition probabilities and stationary probabilities
2. Generating a sample path of a Markov chain and estimating the transition probabilities
3. Classification of the states of a Markov chain and computation of absorption probabilities and mean recurrence times
4. Resampling methods
5. UMPU tests
6. Likelihood ratio tests
7. Wald test and Rao's score test.
8. Confidence intervals- pivotal quantity method.
9. UMA and UMAU confidence intervals
10. Large sample confidence intervals based on CAN estimates

STA 307: Practical Paper

(Assignments based on STA 302 and Elective – I)

(4 hours / Week)

(2 credits)

1. Naïve Bayes Classification
2. EM algorithm
3. Neural networks
4. Classification and regression trees
5. Support vector machine
6. LASSO and LARS regression
7. ROC analysis.

8 – 10 Assignments based on Elective - 1

Open Elective: STATISTICAL METHODS

(52 hours : 4 credits)

Unit 1

Statistics: meaning and role as a decision making science. Data types and scales of measurement. Descriptive Statistics: measures of central tendency, positional averages, measures of dispersion, skewness, and kurtosis. Presentation: tables, diagrammatic and graphical methods. Exploratory data analysis using descriptive measures and graphical tools.

10 hrs

Unit 2

Probability theory: random experiment, sample space, simple events, types of events, probability of an event, rules of probability, conditional probability, Bayes theorem. Random variables - discrete and continuous types. Probability distributions: Bernoulli, binomial, Poisson and normal distributions and their applications.

10 hrs

Unit 3

Sampling methods: population and sample, parameter and statistic, concept of a random sample, simple random sampling, stratified sampling, systematic sampling, sample size determination.

8 hrs

Unit 4

Testing of hypothesis: null hypothesis, alternate hypothesis, test statistic, level of significance, p-value. Testing hypothesis about population mean, tests for proportions. Confidence intervals. Contingency tables, chi-square test for independence of attributes.

12 hrs

Unit 5

Bivariate data, correlation, scatter plot, correlation coefficient and its properties, testing for correlation coefficient, rank correlation coefficient. Regression: linear relationship, linear regression model, simple linear regression, fitting the regression model, coefficient of determination, standard error of the estimate of the regression coefficient.

12 hrs

References

1. Campbell, R.C. (1974). *Statistics for Biologists*, Cambridge University Press, London.
2. Chatfield, C. (1981). *Statistics for Technology*, Chapman and Hall, London.
3. Frank, H. and Athoen, S.C. (1997). *Statistics: Concepts and Applications*, Cambridge University Press, London.
4. Medhi, J. (1992). *Statistical Methods: An Introductory Text*, Wiley Eastern, New Delhi.
5. Lind, D.A., Marchal, W.C., and Wathen, S.A. (2012). *Basic Statistics for Business and Economics*, McGrawHill, London.

FOURTH SEMESTER

STA 401: STATISTICAL INFERENCE – III

(52 hours : 4 credits)

Unit 1

Decision Theory and Bayesian Analysis: Elements of a decision problem. Estimation and testing as decision problems. Bayes paradigm. Prior and posterior distributions. Conjugate and non-informative priors. Construction of Bayes estimators relative to squared error, weighted squared error, absolute error, Stein and LINEX loss functions. Minimax estimation. **12 hrs**

Unit 2

Parametric empirical Bayes estimation: Application in binomial and normal models. Hierarchical Bayes estimation, Bayesian credible intervals. Predictive distributions. Admissibility and inadmissibility, inadmissibility of sample mean vector from a normal distribution. Application to statistical computing through MCMC. James -Stein estimator. Bayes and minimax tests. **10 hrs**

Unit 3

Introduction to sequential procedures. Stopping time. Wald equation. Sequential probability ratio test: termination property, approximations to stopping bounds and construction of SPRT for standard distributions. Statement of Wald fundamental identity. Operating characteristic and average sample number functions and their plotting.

10 hrs

Unit 4

Nonparametric Tests: Definition of U-statistic and properties. Hoeffding's one-sample U – statistic theorem. Tests for randomness. Standard one and two sample nonparametric tests for location. Mood's test for two sample scale problem, Kolmogorov – Smirnov tests. Analysis of variance by ranks. **12 hrs**

Unit 5

Discrete data analysis: Binary variables, inference for proportions. Relative risk and odds Ratio. Categorical variables. Two-way contingency tables: Probability structure, comparing proportions, inference for odds and log-odds ratios, chi -square tests of independence for ordinal data, Fisher's exact test. Small sample inference. Three- way contingency tables-partial and conditional association, Simpson's paradox, conditional and marginal odds ratios. **8 hrs**

References

1. Berger, J. O. (1980). *Decision Theory and Bayesian Analysis*, John Wiley, New York.
2. Carlin, B. P. and Louis, T. A. (2000). *Bayes and Empirical Bayes Methods for Data Analysis*, 2/e, Chapman and Hall, London.
3. Ghosh, B. K. (1970). *Sequential Tests of Statistical Hypotheses*, Addison Wesley, New York.

4. Gibbons, J.D. (1985). *Nonparametric Statistical Inference*, Marcel Dekker, New York.

5. Kale, B. K. and Muralidharan, K. (2015). *Parametric Inference: An Introduction*, Narosa, New Delhi.

6. Lehmann, E. L. and Casella, G. (1998). *Theory of Point Estimation*, 2/e, Springer-Verlag, New York.

7. Randles, R. H. and Wolfe, D. A. (1987). *Introduction to the Theory of non-parametric Statistics*, John Wiley and Sons, New York.

8. Rohatgi, V. K. and Saleh, A. K.Md.E. (2002). *An Introduction to Probability and Statistics*, John Wiley, New York.

9. Sinha, S. K. (1988). *Bayesian Estimation*, New Age International, New Delhi.

10. Wald, A. (1949). *Sequential Analysis*, John Wiley, New York.

STA 402: DESIGN AND ANALYSIS OF EXPERIMENTS

(52 hours : 4 credits)

Unit 1

Introduction to design of experiments. Fixed, random and mixed effects models. General block designs: C matrix and its properties, concepts of connectedness, orthogonality, variance balance. Intra block analysis of general block design: Estimability, best point estimates, interval estimates of estimable linear parametric functions and testing of linear hypotheses. **10 hrs**

Unit 2

BIBD and: Parameter relationship, properties estimation and Intra block Analysis. Youden Square design: Intra block Analysis. Multiple comparison tests: Scheffe, Tukey, Duncan and Dunnett's procedures. Model adequacy checking. Missing plot techniques for RBD and LSD. **12 hrs**

Unit 3

Two-way classification with interaction: Analysis, Tukey's test for non-additivity, test for interaction in multiple but equal number of observations per cell. Two –way random effects model: variance estimation and tests of hypotheses. **8 hrs**

Unit 4

Factorial experiments: concepts, symmetric factorial experiments. Analysis of 2^n and 3^n factorial experiments in randomized blocks. Complete and partial confounding, Layout and analysis of confounded 2^n and 3^n factorials. Fractional replication for 2^n factorials.

16 hrs

Unit 5

Analysis of covariance for CRD and RBD. Split-plot experiments in RBD.

6 hrs

References

1. Dey, A. (1986). *Theory of Block Designs,* Wiley Eastern, New Delhi.
2. Dean, A. and Voss, D. (1999). *Design and Analysis of Experiments*, Springer, New York.
3. Das, M. N. and Giri, N. (1979). *Design and Analysis of Experiments*, Wiley Eastern, New Delhi.
4. John, P. W. M. (1971). *Statistical Design and Analysis of Experiments*, Macmillan, London.
5. Mukhopadhyay, P. (1998). *Applied Statistics*, Allied Publishers, New Delhi.
6. Joshi, D. D. (1987). *Linear Estimation and Design of Experiments*, Wiley Eastern, New Delhi.
7. Montgomery, D.C. (2004). *Design and Analysis of Experiments*, 5/e, Wiley, New York.
8. Pearce, S. C. (1984). *Design of Experiments,* Wiley, New York.
9. Chakrabarti, M.C. (1962). *Mathematics of Design and Analysis of Experiments*, Asia Publishing House, New Delhi.
10. Kempthorne, O. (1952). *Design and Analysis of Experiments,* Wiley Eastern, New Delhi.
11. Cochran, W.G. and Cox, G. M. (1957). *Experimental Designs*, 2/e, John Wiley, New York.

STA 405: Practical Paper

(Assignments based on STA 401, Elective – II and Elective – III)

(4 hours/ Week)

(2 credits)

1. Construction of SPRTs
2. OC and ASN curves for SPRTs
3. Non-parametric Tests
4. Bayes and Minimax Rules

5 – 7 Assignments from Elective II

8 – 10 Assignments from Elective III

STA 406: Practical Paper

(Assignments based on STA 402)

(4 hours / Week)

(2 credits)

1. Two – way ANOVA
2. Missing Plot Techniques for RBD and LSD
3. Analysis of Covariance for CRD
4. Analysis of Covariance for RBD
5. Analysis of BIBD and Youden square Design
6. Analysis of 2^3 and 2^4 factorial experiments
7. Analysis of 3^2 and 3^3 factorial experiments
8. Confounding in 2^3 factorial experiments
9. Confounding in 3^2 and 3^3 factorial experiments
10. Analysis of split – plot experiments.

ELECTIVE PAPERS

S1: SURVIVAL ANALYSIS

(52 hours : 4 credits)

Unit 1

Basic Elements and Parametric Interference: Parametric models for study of life time: Exponential, Raleigh, Weibull, extreme value, gamma, Pareto, logistic, normal and log – normal. Survival function, hazard rate, cumulative hazard function, and mean residual life. Longitudinal studies.

12 hrs

Unit 2

Censoring mechanisms: type I, type II and random censoring. Parametric estimation with complete and censored samples. Large sample tests under censored data. The E – M algorithm.

8 hrs

Unit 3

Nonparametric Inference: Life table, Actuarial Estimator, Kaplan – Meier (product – limit) estimation. Self consistency. Statement of asymptotic properties of K – M estimator. Nelson-Aalen Estimator. Treatment of ties (Peto's method). Weighted log – rank estimator. Two – sample methods. Gehan and Mantel – Haenszel test and Tarone-Ware tests.

14 hrs

Unit 4

Semi-parametric Inference: Cox proportional hazards model. The partial likelihood justification. Statement of asymptotic properties of the estimator. Estimation of the baseline hazard function. Residuals and model checking., Graphical methods: Hazard plots and Survival plots. **10 hrs**

Unit 5

Regression for grouped data: logistic and proportional hazards approaches. Accelerated models. Competing risk model and estimation of cumulative hazard function.

8 hrs

References

1. Kalbfleisch, J. D. and Prentice, R. L. (2002). *The Statistical Analysis of Failure Time Data*, 2/e, Wiley, New York.
2. Lawless, J. F. (1982). *Statistical Models and Methods for Lifetime Data*, Wiley, New York.
3. Nelson, W. (1982). *Applied Life Data Analysis*, Wiley, New York.
4. Miller, J. (1980). *Survival Analysis*, Wiley, New York.
5. Klein, J. P. (2003). Survival Analysis, Springer Verlag, New York.
6. Kleinbaum, D. G. (1997). *Survival Analysis*, Springer Verlag, New York.

S2: OPERATIONS RESEARCH

(52 hours : 4 credits)

Unit 1

Queueing systems: General description and characteristics of a queueing system. M/M/1 and M/M/c queueing systems and their waiting time distributions. M/M/1/N and $M/M/\infty$ queues. Transient solution of $M/M/\infty$ queueing system. Non-Markovian queues. Imbedded Markov chain analysis of M/G/1 and GI/M/1 queues. Pollackzek – Khintchine formula. **14 hrs**

Unit 2

Inventory models: Basic characteristics of inventory systems (models). ABC analysis Deterministic inventory systems EOQ Models with quantity discounts, price breaks, and storage limitations. Multiperiod dynamic inventory models. Continuous review stochastic inventory systems. The (s, S) policy. Multiperiod stochastic inventory systems.

12 hrs

Unit 3

Integer programming: Pure and mixed Integer programming problems. Cutting plane methods – Gomory's algorithms. Branch and bound technique. Zero-one programming.

10 hrs

Unit 4

Nonlinear programming: Formulation of nonlinear programs. Unconstrained and constrained optimization problems. The Lagrangian method. Karush-Kuhn-Tucker optimality conditions. Quadratic programming. Wolfe's modified simplex method. Sequential unconstrained minimization technique (SUMT). **8 hrs**

Unit 5

Dynamic programming: Multistage dynamic programming. Bellman's principle of optimality. General formulation. Forward and backward recursion, computational methods, and applications of dynamic programming. Dynamic lot size determination. **8 hrs**

References

1. Gross, D and Harris, C. M. (1986). *Fundamentals of Queueing Theory*, 2/e, John Wiley.
2. Taha, H. A. (2002). *Operations Research*, 7/e; Macmillan.
3. Medhi. J. (1991). *Stochastic models in queueing theory*, Academic Press.
4. Bazaara, M. S. and Shetty, C. M. (1979). *Nonlinear Programming: Theory and Algorithms*, John Wiley, New York.
5. Hillier, F. S. and Liebermann, G. J. (1986). *Introduction to Operations Research*, Holden Day, New York.
6. Kambo, N. S. (1991). *Mathematical Programming Techniques*, Affiliated East-West Press, New Delhi.
7. Murthy, K. G. (1995). *Operations Research: Deterministic Optimization Models*, Prentice Hall, New Delhi.
8. Swarup, K. et. al. (1985). *Operations Research*, Sultan Chand and Co., New Delhi.
9. Wayne, L. W. (1996). *Introduction to Mathematical Programming*, 2/e, Duxbury Press, New York.

S3: TIME SERIES ANALYSIS

(52 hours : 4 credits)

Unit 1

Exploratory Time Series Analysis, test for randomness, Tests for trend and seasonality. Estimation of trend by moving average, estimation of seasonal effect for additive and multiplicative models, deseasonalising and detrending an observed time series.

6 hrs

Unit 2

Time-series(t.s) as discrete parameter stochastic process, definition of strict and weak stationarity of a t.s., Gaussian t.s., ergodicity, autocovariance and autocorrelation functions(ACF) and their properties, partial autocorrelation function(PACF). Genaral linear processes(G.L.P), autocovariance generating function, stationarity and invertibility conditions of a G.L.P; autoregressive processes(AR(p)), stationarity condition, ACF, PACF, Yule-Walker equations, Moving average (MA(q)) processes, Invertibility condition, ACF, PACF, duality between AR(p) and MA(q) processes; ARMA(p,q) processes, stationarity, invbertibility, ACF, PACF, particular cases of these processes.

18 hrs

Unit 3

Linear Non-stationary time Series models: ARIMA(p,d,q) processes, general form, three explicit forms, IMA(0,1,1) process, seasonal ARIMA processes. Forecasting : minimum mean square error forecast, BLUP, three basic forms for the forecast, forecast error and its properties, examples; forecasting through exponential and Holt-Winter smoothing.

12 hrs

Unit 4

Estimation: sample ACF. Sample PACF, fitting AR(p), MA(q), ARMA(p,q) models; model identification: determination of p, d, q: method of differencing, unit root test, using sample ACF, sample PACF, Bartlett, Quenouille and Anderson bounds; diagnostics: residual analysis, Box-Pierce postmanteau statistic, Ljung-Box test; AIC and BIC criteria.

10 hrs

Unit 5

Time series models of heterocsedasticity: Some common features of financial t.s., ARCH and GARCH models, test for ARCH effect, maximum likelihood estimation.

6 hrs

References

1. Anderson, T. W. (1971). *The Statistical Analysis of Time Series,* Wiley, New York.
2. Box, G. E. P, Jenkins, G. M, Reinsel, G. C. and Ljung, G. M. (2015). *Time Series Analysis - Forecasting and Control,* 5/e, Wiley.
3. Brockwell, P. J. and Davis, R. A. (2002). *Introduction to Time Series and Forecasting*, 2/e, Indian Print, Springer, New Delhi.
4. Brockwell, P. J. and Davis, R. A. (1991). *Time Series: Theory and Methods*, 2/e, Springer, New York.
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6. Chatfield, C. (2003). *Analysis of Time Series: An Introduction*, CRC Press, New Delhi.
7. Nachane, D. M. (2006). *Econometrics: Theoretical Foundations and Empirical Perspectives*, Oxford University Press, London.
8. Cryer, J. D. and Chan, K. S. (2008). *Time Series Analysis with Application in R*, 2/e, Springer, New York.
9. Kendall, M. G. and Ord, J. K. (1990). *Time Series*, 3/e, Edward Arnold, New York.
10. Montgemory, D. C. and Johnson, L. A. (1977). *Forecasting and Time Series Analysis*, McGrawHill, New York.

S4: STATISTICS OF FINANCE AND INSURANCE

(52 hours : 4 credits)

Unit 1

Basic concepts of financial markets - stocks, shares and assets. Put and call options, exercise price and exercise time. Arbitrage and hedging. Interest rates. Returns and log-returns. Random walk model, lognormal model. Call options. Law of one price. Simple binomial model and multiperiod binomial model. Option pricing. Arbitrage theorem.

12 hrs

Unit 2

Brownian motion and geometric Brownian motion models. Applications in stock market analysis. The Black-Scholes formula and its properties. The Greeks. Delta hedging arbitrage strategy. Volatality and estimating the volatility parameter. **10 hrs**