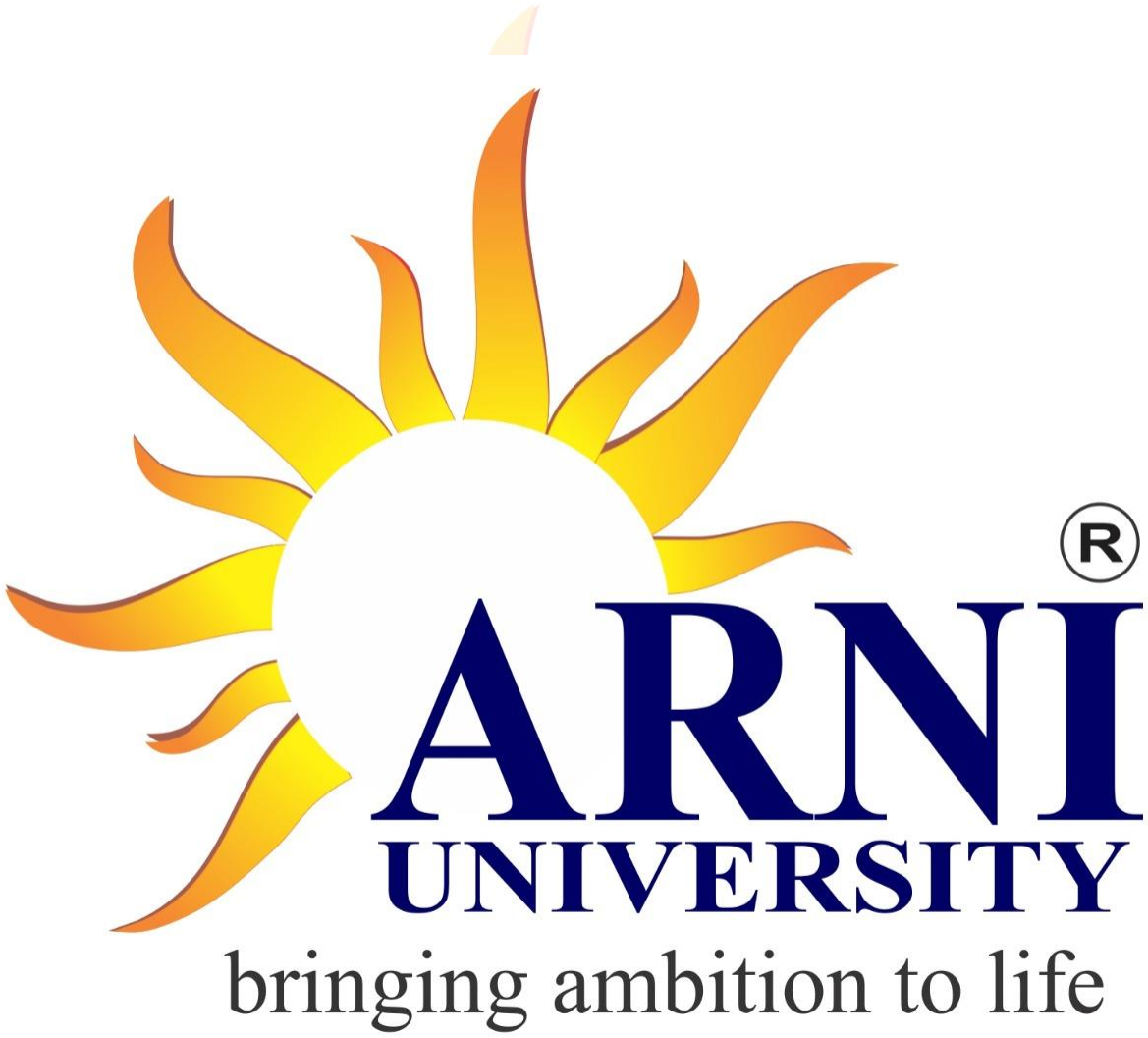
PhD Entrance Examination Syllabus- 2021-22



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PhD stands for Doctor of Philosophy, which is a title that is desired by a lot of individuals who are interested in devoting their careers to research in a particular field. This is a title that is also desired by many individuals who aspire to be educators to future generations. The most common way to get a PhD is by applying for various entrance exams that facilitate the individual to get a PhD. Here are some reasons why a PhD is necessary today:

- A PhD offers the holder a guaranteed job in a university or college. Depending upon the subject, candidates can secure jobs in law firms, consultancies or even publishing houses.
- The mastery and expertise over the subject matter gives the candidate an edge over the competition.
- And the most valuable asset of all - better reputation in terms of qualification.

The subjects and topics included in PhD Syllabus vary based on the PhD specialization and sub-stream one chooses. The subjects included in PhD Syllabus focus on the research and practical aspects of the subject, with a little focus on theoretical knowledge.

PhD Entrance Exam Paper Pattern: The model PhD Entrance Test Pattern consists of two parts:

Part A: It is compulsory and consists of 45 questions on Research Methodology

Part B: It involves 45 discipline specific questions

Table of Content

Part A : Research Methodology

Introduction to Research: Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India.

Defining the Research Problem: What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, factors affecting RDs, Relation among RDs, Developing a Research Plan.

Sampling design and Procedures: Sample or Census, The Sampling Design Process, A Classification of Sampling Techniques, Choosing Nonprobability Versus Probability Sampling, Uses of Non probability Versus Probability Sampling.

Measurement and Scaling: Non-comparative Scaling Techniques, Continuous Rating Scale, Itemized Rating Scale, Non-comparative Itemized Rating Scale Decisions, Multi-item Scales, Scale Evaluation, Choosing a Scaling Technique.

Methods of Data Collection: Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection.

Questionnaire & form design: questionnaire & observation forms, questionnaire design process.

Data analysis: tests of significance based on t, f and z distribution chi-square test; cross tabulation

Multiple Regression: Overview of Multiple Regression, Statistics Associated with Multiple Regression, Conducting Multiple Regression, Stepwise Regression, Multicollinearity

Discriminant Analysis: Discriminant Analysis Model, Statistics Associated with Discriminant Analysis, Conducting Discriminant Analysis

Part B

I. Civil Engineering

Engineering Mathematics

(a) **Linear Algebra:** Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors.

(b) **Calculus:** Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima; Taylor series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities; Directional derivatives; Line, Surface and Volume integrals.

(c) **Ordinary Differential Equation (ODE):** First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; initial and boundary value problems.

(d) **Partial Differential Equation (PDE):** Fourier series; separation of variables; solutions of one dimensional diffusion equation; first and second order one-dimensional wave equation and two dimensional Laplace equation.

(e) **Probability and Statistics:** Sampling theorems; Conditional probability; Descriptive statistics – Mean, median, mode and standard deviation; Random Variables – Discrete and Continuous, Poisson and Normal Distribution; Linear regression.

(f) **Numerical Methods:** Error analysis. Numerical solutions of linear and non-linear algebraic equations; Newton's and Lagrange polynomials; numerical differentiation; Integration by trapezoidal and Simpson's rule; Single and multi-step methods for first order differential equations.

Structural Engineering

(a) **Engineering Mechanics:** System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system.

(b) **Solid Mechanics:** Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural

and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses.

(c) **Structural Analysis:** Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis.

(d) **Concrete Structures:** Working stress and Limit state design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams.

(e) **Steel Structures:** Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis - beams and frames.

Geotechnical Engineering

(a) **Soil Mechanics:** Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two - dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; Onedimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths.

(b) **Foundation Engineering:** Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes, Bishop's method; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations – dynamic and static formulae, Axial load capacity of piles in sands and clays, pile load test, pile under lateral loading, pile group efficiency, negative skin friction.

Water Resources Engineering

(a) **Fluid Mechanics:** Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth; Concept of lift and drag.

(b) **Hydraulics:** Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow and water surface profiles.

(c) **Hydrology:** Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation and routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

(d) **Irrigation:** Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures.

II. Computer Science & Engineering

Mathematical Techniques

1. Linear Algebra

• Mathematical operations with matrices (addition, multiplication)
• Matrix inverses and determinants
• Solving systems of equations with matrices
• Euclidean vector spaces
• Eigenvalues and eigenvectors
• Orthogonal matrices
• Positive definite matrices
• Linear transformations
• Projections
• Linear dependence and independence
• Singular value decomposition

2. Calculus

• Continuity and Differentiability
• Mean value Theorems
• Evaluation of Definite and Improper Integrals
• Surface and Volume Integrals
• Gauss and Green's Theorems

3. Differential equations

• Higher Order Linear Differential Equations with Constant Coefficients
• Laplace and Fourier Transforms
• Solutions of one-Dimensional Diffusion
• Wave Equations
• Laplace Equation

4. Probability and Statistics

• Definitions of Probability and Sampling Theorems
• Normal and Binomial Distributions

5. Numerical Methods

• Finite Differences
• Numerical Integration
• Numerical Solutions of Linear and Non-Linear Algebraic Equations

Computer Science and Engineering

6. Data Structures

• Advanced Sorting Methods
• Algorithm Design Paradigms
• Complexity of Algorithm
• Depth-first and Breadth-first Algorithms
• Kinetic Data Structures

7. Algorithms

• Asymptotic analysis
• Asymptotic notation
• Basic concepts of complexity classes
• Connected components
• Dynamic programming
• Notions of space and time complexity
• Tree and graph traversals
• Worst and average case analysis
• Computational Geometry
• Growth of Functions
• Heuristic Methods

8. Computation Theory

• Regular Languages and Finite Automata
• Languages and Pushdown Automata
• Recursively Enumerable sets and Turing Machines

9. Operating Systems

• Agreement Protocols for handling Processor Failures
• Comparative Performance Analysis
• Distributed Mutual Exclusion
• Distributed Operating Systems
• Local and Global states
• Process Deadlocks
• Resource Models
• Synchronization Mechanisms
• Coordination of Processes and related Algorithms
• Failure Handling and Recovery Mechanisms
• Multiprocessor Operating Systems and related Thread Handlings
• Token and Non-token based Algorithms
• Database Systems

10. Database design

• Indexing and Hashing
• Relational model
• Storage and File Structures
• Extended Relational Model

• Mobile Databases and Web-enabled Database Systems
• Transactions and Concurrency control

11. Computer Organization and Architecture

• Cache and main memory
• CPU control design
• Design and synthesis of combinational and sequential circuits
• Instruction pipelining
• Machine instructions and addressing modes
• Number representation and computer arithmetic
• Secondary storage
• Structured Memory Design for Parallel Systems

12. Software Engineering

• Team Software Process
• Systems Modeling Language
• Requirement and feasibility analysis
• Process Models- Iterative
• Planning and managing the project
• Personal Software Process
• Domain specific modeling
• Software architecture and design patterns
• Software reliability and Advanced testing techniques
• Aspect oriented programming

13. Computer Networks

• LAN technologies
• Application layer protocols
• Flow and error control techniques
• Introduction to intelligent networking
• Performance analysis of networks

III.Mathematics

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, and 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.

IV. Botany

UNIT-I: Algae:classification, Salient features of major divisions; Ecological and economic importance of Algae. Fungi:Classification of fungi; general characters, Fungal associations and their significance; Agricultural significance of Fungi. Bryophyta:Classification and general characters; economic importance Pteridophyta: Classification and general characters of Pteridophytes Gymnosperms: General characteristic features of Gymnosperms and their affinities with pteridophytes and angiosperms; classification of Gymnosperms; Distribution of Gymnosperms in India.

UNIT II: Introduction to the Angiosperms: Taxonomic History; classification; Keys for identification of plants; Basal angiosperms and Magnoliids; Basal monocots; Petaloid monocots; Commelinids; Basal eudicots and Caryophyllids; Rosids; Asterids. Botanical Nomenclature: Kinds of names; ICBN, Names according to rank; Citation of authors; Priority; Type method; Naming a new species; Legitimacy; Synonyms. Phylogenetics: The nature of phylogeny; How we depict phylogeny? The importance of homology, Polarizing characters of homology; The problem of homoplasy.
Salient Features and Economic Importance ofMonocot/Dicot Families:Apocyanaceae; Verbenaceae; Chenopodiaceae; Capparidaceae; Caryophyllaceae; Myrtaceae; Apiaceae; Acanthaceae; Moraceae; Rubiaceae; Amaranthaceae; Musaceae; Cannaceae; Commelinaceae. Origin and economic significance of the following: Medicinal and aromatic plants; Fiber yielding plants, Spices and condiments; cereals, pulses, Rubber yielding plant; tea, coffee, Oil yielding plants; source and uses of plant based insecticides

UNIT-III: Plant Cell and Tissue Culture: Principles, Cellular totipotency; Somatic embryogenesis and synthetic seeds, Somatic hybridization; Application in biotechnology. Plant Breeding: Objectives, domestication and centres of origin of cultivated plants. Hybridization: Role and methods, Back-cross breeding. Pedigree method; Bulk method; Single-seed descent method; Heterosis, Inbreeding depression. Breeding for resistance: Breeding for biotic and abiotic stresses, physical and chemical mutagens; Gamma gardens; Heritability and its Methods of estimation; Reciprocal recurrent selection; Reciprocal recurrent selection based on test cross of

half-sib families; Reciprocal recurrent selection based on half-sib progenies of prolific plants; Reciprocal full-sib recurrent selection.
Phytopathology: process of infection and pathogenesis, Defense mechanism in plants, Diseases in plants: Symptoms, etiology and disease cycle. Wheat- rust, smut; Rice-sheath blight; Cucurbits-Powdery mildew; Sugarcane-red rot; Potato-late and early blight; Crucifers-white rust; dieback disease of grasses. Chemical and biological means of disease control.

UNIT-IV: Genome: Genome organization in prokaryotes and eukaryotes, Nuclear DNA content; law of DNA constancy and C-value paradox; Cot curves, chromosomes, linkage and genetic mapping, gene mapping methods, transposons Prokaryotic & eukaryotic DNA replication, Prokaryotic and eukaryotic transcription, Protein synthesis and processing, Control of gene expression at transcription and translation level, Transgenic Plants, recombinant DNA technology, Gene Transfer Methods in Plants (direct gene transfer methods; restriction endonucleases, ligases, applications of genetic engineering; floral-dip

UNIT-V Biomolecules: biomolecules (composition, structure and function), stablizing interactions, conformation of proteins; conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA); stability of proteins and nucleic acids. Physiology: Water and Plant Cells; Mineral Nutrition, photosynthesis in higher plants; plant respiration, Phytochromes and cryptochromes; Photoperiodism., Plant Hormones, principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes; Stress physiology, Nitrogen metabolism, Physiology of flowering, seed germination, senescence

UNIT-VI: Ecology and Environment: Definition, history and scope of ecology, sub divisions of ecology, ecology vs environmental science. Interdisciplinary nature of environmental science. Evolution and Natural Selection, Ecological succession, Ecosystem organization: Structure and functions; primary production; energy dynamics; global biogeochemical cycling and ecosystem nutrient cycles, primary and secondary productivity, food chains, food webs, ecological pyramids, energy flow and nutrient cycles.
Environment Protection: Conservation of Soil, Agriculture, Biodiversity, aquatic systems; Bioremediation, Phytoremediation, Endangered and threatened species. International concern and efforts for environmental protection, Earth Summits.

Global warming; Climate change. Phytogeography: Climate, vegetation and botanical zones of India, Application of remote sensing invegetation classification,

UNIT-VII Techniques: Microscopy, Chromatographic techniques, Centrifugation, Electrophoresis and Isoelectric focusing, Molecular techniques: Random Fragment Length Polymorphism (RFLP); Fluorescence In-Situ Hybridization (FISH), Genomic In-Situ Hybridization (GISH), Fiber-FISH, Q-FISH; Flow FISH: Flow Cytogenetics, Flow karyotyping; Random amplified polymorphic DNA. Proteomics, Separation and identification of cellular proteins, Genomics, genome sequencing strategies.

V. ZOOLOGY

Unit 1 : Systematics and Animal Diversity :

Systematics : Principles of Animal taxonomy, Carl Linnaeus taxonomic hierarchy, binomial nomenclature, species concept and taxonomic procedures; Major and minor phyla-diagnostic features with example for each phylum and their classification.

Non-chordata : Organization of Metazoans; amoeboid, flagellate and ciliary locomotion; hydrostatic movement; patterns of feeding and digestion in lower metazoans, respiratory organs and pigments, osmoregulation, excretory organs; primitive and advanced nervous system, sense organs and their importance; larval forms and importance of invertebrate fossils.

Chordata : Origin of chordates, systematic position of protochordates and vertebrates, nature of vertebrate morphology, homology and analogy, parallelism and convergence; classification of vertebrates, vertebrate integument and its derivatives; evolution of circulatory, respiratory and urinary systems; Development and organization of brain, spinal cord, nervous system and sense organs; Adaptive radiation of vertebrates.

Unit 2 : Environmental Biology and Wildlife :

Environment : Abiotic and biotic factors, bio-geochemical cycles, population ecology, demography; air, water and soil pollution; Fresh and marine water ecology; Food chain and food web; Conservation and management of natural resources; Environmental education, Environmental monitoring and EIA; microbial ecology, ecological role of microorganisms.

Wildlife : Values of wildlife, causes of wildlife depletion, human-wildlife conflicts, wildlife and human welfare, conservation strategies - in-situ and ex-situ conservation, wildlife act and legislation, conservation projects in India, Biosphere reserves, National Parks, sanctuaries; Biodiversity profile of India and Karnataka, Biodiversity hotspots.

Unit 3 : Developmental Biology - Molecular events during fertilization, nucleo-cytoplasmic interactions in development, cleavage and gastrulation, morphogenetic determinants, laying down embryonic body plan - Drosophila and mammals; competence, determination; induction, early embryogenesis in Drosophila - gap genes, pair rule genes, segment polarity genes and

Homeotic genes, post embryonic development; Role of ecdysone and thyroxin in metamorphosis; sources of cells for regeneration; teratogenesis.

Unit 4 : Biological chemistry – Chemistry of DNA and RNA, Watson-Crick model of DNA, cyclic nucleotides; vitamins as co-enzymes, trace elements; chemical bonds, Vander-waal's force, normality and molarity of solutions; chemistry and biological properties of carbohydrates and lipids; nomenclature of enzymes, enzyme dynamics, enzyme inhibition, ribozymes and abzymes; colorimetry, spectrophotometry, TLC, HPLC, electrophoresis, ELISA.

Unit 5 : Applied Zoology-Insect pests of major crops, plant-insect interaction, insect pest control strategies, IPM; Insect vectors of diseases, epidemiology of - malaria, filariasis, leishmaniasis, Japanese encephalitis, dengue, chikungunya; silkworm races and culture practices, lac culture, venomous insects; fisheries of India, culture practices of-fish, prawn and oyster.

Unit 6 : Basic and advanced genetics- Mendelian principles in haploid organisms (*Chlamydomonas* and *Neurospora*), tetrad analysis, dominance relationships, allelic variation and gene function, types of mutations, molecular mechanisms of mutations, methods of detection of mutations, P-mediated mutagenesis; genome in prokaryotes and eukaryotes, c-value paradox, split genes, mobile genetic elements, mapping of genome, linkage, molecular markers; comparative genomics of *C. elegans*, *Drosophila*, mouse and *Homo sapiens*; bacterial transformation, transduction and conjugation; morphogenesis and recombination in bacteriophages.

Unit 7 : Cell and Molecular Biology–Ultrastructure of cell organelles and their function; biology of cancer; biology of immune system; gene regulation in prokaryotes and eukaryotes; genetic code; DNA replication, transcription and translation in prokaryotes and eukaryotes, molecular mechanisms of DNA repair, principles and applications of recombinant DNA technology.

Unit 8 : Reproductive Biology and Endocrinology–Functional morphology of female reproductive system - ovary and accessory organs; Functional morphology of male reproductive system - testis and accessory organs; Fertility control methods - barrier, surgical and hormonal; Structure and function of endocrine organs - adrenal, pituitary, thyroid, parathyroid, pancreas, pineal, hypothalamus, ovary and tests; Mechanism of action of endocrine organs.

Unit 9 : Animal Physiology - Aerobic and anaerobic break down of glucose, stepwise release of energy and production of ATP, exchange (at respiratory surface) and transport of respiratory gases; Composition of blood, cardiac cycle, ECG; Different modes of nitrogen excretion, molecular organization of sarcomere and mechanism of muscle contraction; transmission of nerve impulse, sensory transduction, tolerance and resistance; osmoregulation in aqueous and terrestrial environment; thermoregulation.

Unit 10 : Organic Evolution : Darwinism and Neo-Darwinism; Population genetics; Hardy-Weinberg genetic equilibrium and its destabilizing forces; speciation, reproductive isolation, models of speciation, micro and macro-evolution; Neutral theory of evolution, molecular evolution, molecular clock, construction and types of phylogenetic trees.

VI. MECHANICAL ENGINEERING

Engineering Materials: Structure and properties of engineering materials and their applications; effect of strain, strain rate and temperature on mechanical properties of metals and alloys; heat treatment of metals and alloys, its influence on mechanical properties.

Applied Mechanics: Engineering mechanics – equivalent force systems, free body concepts, equations of equilibrium; strength of materials – stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.

Theory of Machines and Design: Analysis of planar mechanisms, cams and followers; governers and fly wheels; design of elements – failure theories; design of bolted, riveted and welded joints; design of shafts, keys, spur gears, belt drives, brakes and clutches.

Thermal Engineering: Fluid mechanics – fluid statics, Bernoulli's equation, flow through pipes, equations of continuity and momentum; thermodynamics – zeroth, first and second law of thermodynamics, thermodynamic system and processes, calculation of work and heat for systems and control volumes; air standard cycles; basics of internal combustion engines and steam turbines; heat transfer – fundamentals of conduction, convection and radiation, heat exchangers.

Metal Casting: Casting processes – types and applications; patterns – types and materials; allowances; moulds and cores – materials, making, and testing; casting techniques of cast iron, steels and nonferrous metals and alloys; solidification; design of casting, gating and risering; casting inspection, defects and remedies.

Metal Forming: Stress-strain relations in elastic and plastic deformation; concept of flow stress, deformation mechanisms; hot and cold working – forging, rolling, extrusion, wire and tube drawing; sheet metal working processes such as blanking, piercing, bending, deep drawing, coining and embossing; analysis of rolling, forging, extrusion and wire /rod drawing; metal working defects.

Metal Joining Processes: Welding processes – manual metal arc, MIG, TIG, plasma arc, submerged arc, electro slag, thermit, resistance, forge, friction, and explosive welding; other joining processes – soldering, brazing, braze welding; inspection of welded joints, defects and remedies; introduction to advanced welding processes – ultrasonic, electron beam, laser beam; thermal cutting.

Machining and Machine Tool Operations: Basic machine tools; machining processes-turning, drilling, boring, milling, shaping, planing, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics of machining – geometry of cutting tools, chip formation, cutting forces and power requirements, Merchant's analysis; selection of machining parameters; tool materials, tool wear and tool life, thermal aspects of machining, cutting fluids,

machinability; principles and applications of nontraditional machining processes – USM, AJM, WJM, EDM and Wire cut EDM, LBM, EBM, PAM, CHM, ECM.

Tool Engineering: Jigs and fixtures – principles, applications, and design; press tools – configuration, design of die and punch; principles of forging die design.

Metrology and Inspection: Limits, fits, and tolerances, interchangeability, selective assembly; linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry; surface finish measurement; inspection of screw threads and gears; alignment testing of machine tools.

Powder Metallurgy: Production of metal powders, compaction and sintering.

Polymers and Composites: Introduction to polymers and composites; plastic processing – injection, compression and blow molding, extrusion, calendaring and thermoforming; molding of composites.

Computer Integrated Manufacturing: Basic concepts of CAD, CAM, CAPP, cellular manufacturing, NC, CNC, DNC, Robotics, FMS, and CIM.

Product Design and Development: Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

Facility Design: Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems.

Production Planning and Inventory Control: Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; MRP and MRP-II; order control and flow control; routing, scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system; logistics, distribution, and supply chain management; Inventory – functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

Operation Research: Linear programming – problem formulation, simplex method, duality and sensitivity analysis; transportation and assignment models; network flow models, constrained optimization and Lagrange multipliers; simple queuing models; dynamic programming; simulation – manufacturing applications; PERT and CPM, time-cost trade-off, resource leveling.

Quality Management: Quality – concept and costs, quality circles, quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000; design of experiments – Taguchi method.

VII.CHEMISTRY

Organic Chemistry: IUPAC nomenclature of organic molecules including regio- and stereoisomers.
Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways. Common named reactions and rearrangements – applications in organic synthesis.
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.
Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
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. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.Structure determination of organic compounds by IR, UV-Vis, 1H & 13C NMR and Mass spectroscopic techniques.
Inorganic Chemistry: Chemical periodicity. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory). Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications. **Organometallic compounds:** synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis. Cages and

metal clusters. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.

Bioinorganic chemistry: photosystems, porphyries, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.

Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry: 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.

Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

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

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.

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

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

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.

Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
Polymer chemistry: Molar masses; kinetics of polymerization.
Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

VIII. MASS COMMUNICATION

Unit - 1
Introduction to and Mass Communication
a. Concept of mass communication, mass communication in India.

b. History, growth and development of print and electronic media. Major landmarks in print and electronic media in Indian languages. Media's role in formulation of states of India.
c. Media criticism and media literacy, Press Council and Press Commissions of India, status of journalism and media education in India. Media policies of the Government of India since Independence.
d. Models and theories of mass communication, normative theories, administrative and critical traditions in communication, media and journalism studies, communication and theories of socio-cultural, educational and agricultural change. Technological determinism, critique of Marshall McLuhan's views on media and communication and Marxist approaches. Information and knowledge societies.
e. Indian traditions and approaches to communication from the Vedic era to the 21st century. Western and Eastern philosophical, ethical and aesthetic perceptions of communication - Aristotle and Plato, Hindu, Buddhist, and Islamic traditions.
f. Media and culture - framework for understanding culture in a globalised world. Globalisation with respect to politico-economic & socio-cultural developments in India.

Unit - 2
Communication for Development and Social Change
a. Concept and definition of development communication, role of media and journalism in society, characteristics of Indian society – demographic and sociological impact of communication, media and journalism. Media and specific audiences.

b. Development and social change. Issues and post-colonial conceptions.
c. Deconstruction of dominant paradigm of communication and development. Responses and critique of dominant models.
d. Corporatisation of development - Corporate Social Responsibility, non-state actors in development, mass campaigns by NGOs, Government of India, international agencies and corporates. Paradigms and discourse of development communication.

e. Emergence of global civil societies, public sphere, global communication system - nation state-universal, national communication policies.
f. Leading influencers of social reform in India - Raja Rammohan Roy, Pandit Madanmohan Malviya, Bal Gangadhar Tilak, Mahatma Jyotiba Phule, Mahatma Gandhi, Acharya Vinoba Bhave, Dr B. R. Ambedkar, Deendayal Upadhyay, Dr Ram Manohar Lohia etc.

Unit - 3
Reporting and Editing
a. News-concepts, determinants (values), structure and perspectives. Reporting for print, radio, television and digital media. Types of reporting. National and international news agencies and feature syndicates, functions and role.
b. Writing for print, electronic and digital news media. Translation and transcreation.
c. Editing and presentation techniques for print, television and digital media.
d. Journalism as profession, reportage of contemporary issues, ethics of reporting.
e. Critique of western news values, effect of new technology on global communication flows.
f. Niche Reporting.

Unit - 4
Advertising and Marketing Communication
a. Definition, concept, functions, types, evolution of advertising, standards and ethics in advertising. Theories and models of communication in advertising.
b. Brand management.
c. Advertising management - agency-role, structure and function, client-agency relationship, media planning and budgeting.
d. Advertising and creativity, language and translation.
e. Advertising campaign and marketing.
f. Advertising and marketing research.

Unit - 5
Public Relations and Corporate Communication
a. Public Relations and Corporate Communication - definition, concept and scope.
b. Structure of PR in State, Public, Private and non-government sectors.
c. Tools and techniques of PR and Corporate Communication.
d. Crisis communication and crisis communication management.
e. Ethics of Public Relations.
f. International Public Relations, communication audit.

Unit - 6

Media Laws and Ethics

a. Concept of law and ethics in India and rest of the world.

b. The Constitution of India, historical evolution, relevance.

c. Concept of freedom of speech and expression in Indian Constitution.

d. Defamation, Libel, Slander-IPC 499-502, Sedition IPC 124(A), Contempt of Courts Act 1971, Official Secrets Act 1923, Press and Registration of Books Act 1867, Working Journalists and other Newspaper Employees (Conditions of Service) and Miscellaneous Provisions Act 1955, Wage Boards, Law of Obscenity (Section 292-294 of IPC); the Miller test, the Hicklin test, Indecent Representation of Women (Prohibition) Act 1986, Scheduled Castes and Tribes (Prevention of Atrocities) Act, 1989, Parliamentary Privileges. Famous cases involving journalists and news media organisations.

e. Right to Information Act 2005, Copyright Act 1957, Intellectual Property Rights, Cable Television Network (Regulation) Act 1995, Information Technology Act (relevant) 2000 and cyber laws, Cinematograph Act 1952, Film Censorship, Press Council Act as amended from time to time, IPR, ASCI, Drugs and Magic Remedies (Objectionable Advertisements) Act, 1954, Various regulatory bodies for print, TV, Advertising, PR, and Internet.

f. Rules, regulations and guidelines for the media as recommended by Press Council of India, Information and Broadcasting ministry and other professional organisations, adversarial role of the media, human rights and media.

Unit – 7

Media Management and Production

a. Definition, concept of media management. Grammar of electronic media.

b. Communication design theories and practice.

c. Media production techniques – print and electronic.

d. Digital media production techniques.

e. Economics and commerce of mass media in India.

f. Principles and management in media industry post liberalisation.

Unit – 8

ICT and Media

a. ICT and media - definition, characteristics and role. Effect of computer mediated communication. Impact of ICT on mass media. Digitisation.

b. Social networking.

c. Economics and commerce of web enabled media.

d. Mobile adaption and new generation telephony by media, ethics and new media.

e. ICT in education and development in India, online media and e-governance.
f. Animation - concepts and techniques.

Unit - 9

Film and Visual Communication

a. Film and television theory.
b. Film and identity in Indian film studies, leading film directors of India before and after Independence. Indian cinema in the 21st century.
c. Approaches to analysis of Indian television.
d. Visual Communication. Visual analysis.
e. Basics of film language and aesthetics, the dominant film paradigm, evolution of Indian cinema-commercial and 'non-commercial' genres, the Hindi film song, Indian aesthetics and poetics (the theory of Rasa and Dhvani).
f. National cinema movements: Soviet Montage cinema, German Expressionistic cinema, Italian Neo-Realistic cinema, French New Wave cinema, British New Wave cinema, Indian New Wave cinema, Period cinema. Cinema in the new millennium.

Unit - 10

Communication Research

a. Definition, concept, constructs and approaches to communication research process.
b. Research Designs - types, structure, components, classical, experimental and quasi experimental, variables and hypotheses; types and methods of research; basic, applied, descriptive, analytical, historical, case study, longitudinal studies.
c. Research in journalism, Public Relations, advertising, cinema, animation and graphics, television, Internet, social media practices, magazines, children's media. Communication, journalism and media research in India.
d. Levels of measurement: sampling-probability and non-probability, tests of validity and reliability, scaling techniques. Methods and tools of data collection-interviews, surveys, case studies, obtrusive and non-obtrusive techniques, ethnography, schedule, questionnaire, dairy, and internet based tools, media specific methods such as exit polls, opinion polls, telephone, SMS surveys and voting with regard to GEC (general entertainment content).
e. Data analysis, testing, interpretation, application of statistical tests-parametric and non-parametric, tests of variance-univariate, bivariate and multivariate, tests of significance, computer mediated research.
f. Ethical considerations in communication, media and journalism research, writing research reports, plagiarism.

IX. ECONOMICS

Micro – Economic Analysis

Demand Analysis – Marshallian, Hicksian and Revealed preference approaches Consumer behaviour under conditions of uncertainty. Theory of Production and Costs. Pricing and output under different forms of market structure. Different models of objectives of the firm – Baumol, Morris and Williamson. Factor Pricing analysis. Elements of general equilibrium and new welfare economics.

Macro – Economic Analysis

Determination of output and employment – Classical approach, Keynesian approach, Consumption hypotheses. Demand for Money – Fisher and Cambridge versions, Approaches of Keynesian, Friedman, Patinkin, Baumol and Tobin. Supply of Money, Determinants of money supply, High – powered money, Money multiplier. Phillips Curve analysis. Business cycles – Models of Samuelson, Hicks and Kaldor. Macro – economic Equilibrium – Relative roles of monetary and fiscal policies Fleming – Mundell open economy model.

Development and Planning

Economic Growth, Economic Development and sustainable Development – Importance of institutions – Government and markets – Perpetuation of underdevelopment – Vicious circle of poverty, circular causation, structural view of underdevelopment – Measurement of development conventional, HDI and quality of life indices. Theories of growth and development – Models of growth of Joan Robinson and Kaldor; Technical Progress – Hicks, Harrod and learning by doing, production function approach to the determinants of growth : Endogenous growth : role of education, research and knowledge – explanation of cross country differentials in economic development and growth.

Theories of Development – Classical, Marx and Schumpeter; Economic Growth – Harrod – Domar model, instability of equilibrium, Neoclassical growth – Solow's model, steady state growth. Lewis model of development, Ranis – Fei model, Dependency theory of development.

Approaches to development: Balanced growth, critical minimum effort, big push, unlimited supply of labour, unbalanced growth, low income equilibrium trap. Indicators and measurement of poverty.

Indian Economy

Basic Economic indicators – National income, performance of different sectors Trends in prices and money supply. Agriculture – Institutional and technological aspects, new agricultural policy Industry – New industrial policy and liberalization. Money and banking – Concepts of money supply, inflation, monetary policy and financial sector reforms.

Public finance – Trends in revenue and expenditures of the Central and State Governments, Public debt; analysis of the Union Budget. Foreign trade – Trends, Balance of payments and trade reforms. Poverty, unemployment, migration and environment.

Quantitative Methods

Measures of Central tendency, dispersion, skewness and kurtosis. Elementary theory of probability – Binomial, Poisson and Normal distributions. Simple correlation and regression analysis. Statistical inferences – Applications, sampling distributions (t, x2 and F tests) sampling of attributes, testing of Hypothesis. Index numbers and time series analysis.Sampling and census methods, types of sampling and errors.

X. COMMERCE

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Unit—I

Business Environment

Meaning and elements of Business Environment. Economic environment. Economic Policies,

Economic Planning.

Legal environment of business in India.

Competition policy. Consumer protection, Environment protection.

Policy Environment: Liberalization, privatisation and globalisation. Second generation reforms,

Industrial policy and implementation, Industrial growth and structural changes.

Unit—II

Financial & Management Accounting

Basic Accounting Concepts, Capital and Revenue, Financial Statements.

Valuation of shares, Amalgamation, Absorption and Reconstruciton, Holding Company Accounts.

Accounting standards - objectives of financial reporting - users of financial statements and their needs. I A S B framework preparation and presentation of financial statements - human resume accounting - social and entvironmental accounting.

Cost and Management Accounting : Ratio Analysis, Funds Flow Analysis, Cash Flow Analysis,

Marginal Costing and Break-even analysis. Standard Costing, Budgetary Control. Costing for Decisionmaking. Responsibility Accounting.

II Financial Accounting

Unit—III

Business Economics

Nature and uses of Business Economics. Concept of Profit and Wealth Maximization. Demand

Analysis and Elasticity of Demand. Curve Analysis Law.

Utility Analysis and Indifference of Returns and Law of variable proportions cost. Revenue.

Price determination in different market situations. Perfect competition, Monopolistic competition.

Monopoly. Price discrimination and oligopoly, Pricing strategies.

Unit—IV

Business Statistics & Data Processing

Data types, Data collection and analysis, sampling, need, errors and methods of sampling.
Normal distribution. Hypothesis testing. Analysis and Interpretation of Data.
Correlation and Regression. small sample tests- t-test f-test and chi-square test.
Data Processing—Elements. Data entry, Data processing and Computer applications.
Computer Application to Functional Areas—Accounting. Inventory control. Marketing.

Unit—V

Business Management
Principles of Management
Planning—Objectives, Strategies, Planning Process, Decision-making.
Organising, Organisational Structure, Formal and Informal Organisations.
Organisational Culture.
Staffing
Leading : Motivation, Leadership, Committees, Communication Controlling.
Corporate Governance and Business Ehtics.

Unit—VI

Marketing Management
The evolution of marketing. Concepts. Concept of marketing, Marketing mix. Marketing
environment.
Elements of consumer behaviour, Market segmentation.
Product decisions.

Pricing decisions.
Distribution decisions.
Promotion decisions.
Marketing planning. Organising and Control.
International Marketing
Advertisement Management
Supply Chain Management

Unit—VII

Financial Management
Capital Structure. Financial and Operating leverage.
Cost of Capital. Capital budgeting.
Working Capital Management.
Dividend Policy.

Unit—VIII

HUMAN RESOURCE MANAGEMENT

HRM- Introduction, meaning, definition, nature and scope of HRM and HRD, evolution of HRM, features of HRM, HRM functions, objectives of HRM, Opportunities and Challenges in Human Resource Management.

Job design, Job analysis, HR planning: introduction, objectives of HRP, linkage of HRP to other plans.

Recruitment: definition, objectives, subsystems, factors affecting, recruitment policy.

Selection, placement and Induction

Performance management: Introduction, meaning, need, purpose, -objectives, contents of PAS, Appraisers and different methods of appraisal, uses of performance appraisal.

Human Resource Development: Introduction, definition, concepts, activities

Training and development: meaning of T & D, importance of training, benefits of training.

Internal mobility: Introduction, meaning, Promotion, Transfer, Demotion.

Career planning and Development: meaning, need, career development, actions.

Compensation & Benefits Administration: Compensation Management: - salary structure, salary fixation, incentives, profit sharing, bonus concepts, ESOPs, pay for performance, Benefits administration, employee welfare and working conditions-statutory and voluntary measures.

Industrial peace and harmony: Discipline maintenance, Grievance Handling, Workers participation in management, maintaining good human and industrial relations, benefits accrued by the organization due to the development of congenial environment.

CRM

E-CRM

Unit—IX

Banking and Finance

Importance of Banking to Business, Types of Banks and Their Functions.

Reserve Bank of India and its functions. NABARD and Rural Banking.

Banking Sector Reforms in India, NPA, Capital Adequacy Norms.

E-banking.

Development Banking : IDBI, IFCI, SFCs, UTI, SIDBI.

International liquidity, International Economic Institutions—IMF, World Bank, IFC, IDA, ADB.

World Trade Organisation—Its functions and policies.

Unit—X

Business Taxation:
Direct Taxes:
- Basic Concepts
- Heads of Income
- Computation of total income
- Corporate income taxation and planning
- Wealth tux

Indirect Taxes
- Theoretical Framework
- Excise Duty
- Customs duty
- VAT and Service Tax
- Proposed GST

XI. ENGLISH

Unit 1

1. Historical Background from 14th to 16th Century – Chaucer's "Prologue"; Sidney: *Sonnets I, V &VI (Astrophel and Stella)*; Spenser: *Prothalamion , Epithalamion*; Surrey : 1*." Love that liveth and reigneth in my thought", 2. " Set me whereas the sun doth parch the green"* ; Wyatt :1. *"Who so list to hunt" , 2. They flee from me*; Donne: "*The Good Morrow", "Song: Go and Catch a Falling Star", "Death be Not Proud", "At the Round Earth's Imagined Corner", "Sunne Rising", "Resurrection"*; Herbert: "*The Pulley", "The Collar", "Virtue", "Discipline*"; Andrew Marvell – *"To His Coy Mistress", "Thoughts in a Garden*" ; Marlowe's *Dr. Faustus;* Jonson's *Volpone;* Kyd's *Spanish Tragedy;* Shakespeare's Sonnets *18,29,30,33, ,60,71,73,114,116; Macbeth; Julius Caesar; As You Like It;*

Unit 2

Historical Background to 17th and 18th Century; *Dryden's Absalom and Achitophel;* Alexander Pope's *The Rape of the Lock;* Bunyan's *Pilgrim's Progress Book-1;* William Congreve - *The Way of the World;* Sheridan's *The School for Scandal;* Aphra Behn's *Ooroonoko (Royal Author);* Daniel Defoe: *Robinson Crusoe*; Jonathan Swift – *Gulliver's Travels – Book IV* (Voyage to the Land of Houyhnhnms); Addison & Steele: Spectator Essays: Addison (1*) Sir Roger at Church*, (2) *Sir Roger at Assizes*; Steele: 1) *The Gentleman* 2) *The Spectator Club*

Unit 3

Historical Background to 19th Century; William Blake's *Tyger*, *London*, *The Chimney Sweeper*, William Wordsworth's *Tintern Abbey*, *Ode to Immortality*, *Lucy Poems*; *A Slumber Did My Spirit Seal*, *She Dwelt Among Untrodden Ways;* P.B. Shelley's *Ode to the West Wind; To A Skylark;* Tennyson's *Ulysses, Lotus Eaters;* Jane Austen's *Emma*; Emily Bronte's *Wuthering Heights*; Charles Dickens' *Hard Times*; Thomas Hardy's *Jude the Obscure;* J.Ruskin: *Unto the Last* (Chs.1 and 2), J.S.Mill: "*On Liberty*"; Mathew Arnold*: Culture and Anarchy* (chapter 1: Sweetness & Light chapter 2: Hellenism & Hebraism);

Unit 4

Historical Background to 20th Century; G.M. Hopkins: *The Wreck of Deutschland, Windhover*; W.B Yeats: *Sailing to Byzantium, Byzantium, Second Coming, Easter 1916,* Thomas Hardy's *Green Slates (Penpethy), The Darkling Thrush, The Man He Killed, The Broken Appointmen*t; T.S. Eliot's *The Wasteland, The Journey of the Magi*; W H Auden's *In Memory of W. B. Yeats, Musee des Beaux Arts,* Sylvia Plath's *The Arrival of the Bee Box: Lady Lazarus;* Dylan Thomas: *After the Funeral, Fern Hill*; Seamus Heaney: *Tollund Man, Digging, Casuality;* Philip Larkin: *Church*

Going, Next Please, Love Again; Ted Hughes: *Thought Fox, Hawk Roosting, Full Moon* and *Little Frieda*

Unit 5

Origin, growth, and development of Literary Criticism, Various Posits and Literary Contexts, Principles of Literary and Practical Criticism; Post World War Scenario, Twentieth Century Social Milieu, Twentieth Century Theatre, Twentieth Century Novel, Great Economic Depression, Stream of Consciousness, Postmodernism, Aristotle: *Poetics;* Longinus: *On the Sublime;* Plato on Mimesis in *A Short History of English Literary Criticism* by Wimsatt & Brooks); Sidney's *Apologie for Poetry;* Samuel Johnson's *Preface to Shakespeare;* Dryden:*On Dramatic Poesy;* W. Wordsworth's *Preface to Lyrical Ballads;* Coleridge :*Biographia Literaria* Chapters 13,14,17; Arnold: *The Function of Criticism at the Present Time;* DH Lawrence: *The Rainbow;* Virginia Woolf: *To the Lighthouse;* E.M.Forster: *A Passage to India;* Doris Lessing: *The Golden Notebook;*Samuel Beckett – *Waiting for Godot;* John Osborne:*Look Back in Anger;* Virginia Woolf: "On Modern Fiction"; George Lukacs: "The Meaning of Contemporary Realism", (chapters on Kafka & Modernist Fiction); Raymond Williams: "When was Modernity?"

Unit 6

Russian Formalism, Psychoanalysis, Structuralism, Deconstruction, Postcolonialism, Phenomenology and certain other forms of Hermeneutics. Marx, Nietzsche, Freud, Gramsci, T.S. Eliot: *Tradition and Individual Talent,* F.R. Leavis: *Literature and Society, Tragedy and the Medium* (From **The Common Pursuit**), C. Jung: *'Psychology and Literature'*, N. Frye: *Archetypes of Literature*, G. Genette: '*Structuralism and Literary Criticism'*, J. Derrida: *'Structure, Sign, and Play in the Discourse of Human Sciences'*, Elaine Showalter: "*Towards a Feminist Poetics*", Helene Cixous: "*The Laugh of the Medusa*"

Unit 7

Anglicists and Orientalists Debates, *Macaulay's Minute*, Rajaram Mohan Roy's *Letter to Lord Amherst*, The Rise of the Indian English Novel, Novel as a Social Act; Colonization and its aftermath, Culture Vs Modernity: The Indian Context , The Modern Indian Psyche vis a vis Indian Writing in English and in Translation; Toru Dutt's *Prahlad; Our Casurina Tree*; Rabindranath Tagore's Gitanjali: First five and last five poems; Sarojini Naidu: *Coromandel Fishers, Indian Weavers*; Girish Karnad: *Hayavadhana;* Vijay Tendulkar: *Silence! The Court is in Session*, Mahesh Dattani: *The Final Solution*; Aurobindo: *Savitri* Canto-I; Mulk Raj Anand: *Untouchable;* Raja Rao: *Kanthapura; R.* .K. Narayan: *The Man Eater of Malgudi;* Hiryanna: *Art Experience*: Indian Aesthetics (Chs. 1 and 2); Ananda Coomaraswamy: "The Dance of Shiva"; Aurobindo: The Poets of Dawn -1&2 (From Future Poetry) Arundathi Roy: *God of Small Things;* Amitav Ghosh: *Shadow Lines* (Partition); Jahnavi Barua : *Next Door;* M. K. Gandhi: *My Experiments with Truth;*

*A*mrita Pritham: *Revenue Stamp; D*om Morales: *My Sons' Father ;* Gayathri Spivak: "Can the Subaltern Speak?", Meenakshi Mukherjhee: "The Anxiety of Indianness", Aijaz Ahamed*: "Introduction*" to ***In Theory***

Unit 8

Philosophy and Aesthetics of Commonwealth Literature, paradigm shifts from commonwealth to New Literatures, Chinua Achebe's *Arrow of God; N*gugi Wa Thiongo *Homecoming* Part-II: (a) The Writer and His Past,(b) The Writer in a Changing Society; Wole Soyinka's *The Lion and the Jewel*; Denis Brutus' *At the Funeral, If This Life is All That We Have*; David Diop's *Africa, Vultures* ; Gabriel Okara: *Piano and Drums. The Call of the River Nun*; Margaret Atwood: *Surfacing N*orthrop Frye : "Conclusion" to *Literary History of Canada*

AJM Smith: *The Lonely Land* ; E.J. Pratt: *The Dying Eagle*; Patrick White: *The Tree of Man*

Judith Wright: *Preoccupations in Australian Poetry* (Chapter 13 on A.D. Hope); Judith Wright: *Woman to Man*, A.D. Hope: *Australia*; V S Naipaul's A*House for Mr. Biswas;W*ilson Harris' *Tradition and the West Indian Novel* ; Derek Walcott: *Almond Trees, A Far Cry from Africa, Mass Man, Missing the Sea;* Braithwaite: *Starvation, Blues, Caliban, Thirst*

Unit 9

American Renaissance, Journey as Metaphor, Westward Movement, Transcendentalism, Emerson: American Scholar, Nature, Thoreau: **Walden** (Chapters on *Economy* & *Where I Lived and What I Lived For*), Emily Dickinson: *Because I Could Not Stop for Death, The Soul Selects her Own Society,* Wallace Stevens: *Emperor of Ice-Cream, Anecdote of The Jar*, Walt Whitman: *When Lilacs Last in the Dooryard Bloomed, A Noiseless Patient Spider*, Robert Frost: *Mending Wall, The Road Not Taken*, Mark Twain: *Huckleberry Finn,* Ernest Hemingway: *The Old Man and the Sea,* Leslie Stephen: *King of the Jews,* Toni Morrison: *The Bluest Eye,* Alice Walker: *The Color Purple,* Fredrick Douglas: *Narrative of the Life of an American Slave*

Unit 10

Introduction to Spanish, French, German and Russian Literatures of the 19th and 20th Century: a. Political , b. Cultural c. Philosophical d. Social with special reference to the authors in the syllabus; Gustave Flaubert: **Madam Bovary;** Franz Kafka : **Metamorphosis,** Cervantes: **Don Quixote;** Fyodor Dostoevsky: **Crime and Punishment**

XII. Management

I - Managerial Economics

Nature and scope of Managerial Economics. Importance of Managerial decision—making; Marginal analysis; Objective of a firm, Demand function, Elasticity of demand and its significance in Managerial decision-making; Consumer equilibrium-utility and indifference curve approach; Price, income and substitution effects; Fundamentals of demand estimation and forecasting; Short-run and long-run production functions; Cost curves and economics of scale; Price and output determination under perfect competition, monopoly, monopolistic, competition, and oligopoly; Pricing strategies and tactics; National Income— alternative concepts aid measurement of National income; Inflation—types, measurement and control; Balance of Payments; Monetary and Fiscal Policies.

II - Business Statistics

Univariate Analysis : An overview of central tendency, dispersion, aid skewness. probability Theory; Classical, relative and subjective probability, - Addition and multiplication probability models; Conditional probability and Baye's Theorem. Probability Distributions: Binomial, Poisson, and normal distributions; Their characteristics and applications. Sampling and sampling methods; Sampling and non-s Sampling erros's; Law of Large Number and Central Limit Theorem; Sampling distributions and their characteristics. Statistical Estimation and Testing; Point and interval estimation of population mean, proportion, and variance; Statistical testing of hypothesis and errors; Large and small sampling tests—Z, t and F tests. Non—Parametric Tests: Chi-square tests; Correlation and Regression Analysis : Two variables case. Index Numbers : Meaning and types; Weighted aggregative indices-Laspeyre's and Paasch's indices; Uses and problems of Index number; Time Series Analysis; Trend Analysis.

III - Business Environment

Nature, components and determinants of business environment, dynamics of business environment, key indicators; Risk in business environment, Assessing business environment — country risk and political risk. Current state of business environment in India Economic reforms — Liberalisation, privatisation, globalisation, industrial policy and industrialisation trends, public enterprise reforms and disinvestment programmes; competitive environment; financial environment. India's current balance of payment position, globalisation trends, Trade reforms & trends, FIJI poky & trends, India's share iii world economy. Trends in global trade & investment; Nature & operations of multilateral economic institutions- World Bank, WTO IMF and their impact on Indian business environment. Factors of global competitiveness.

IV - Operations Research

Management Science - Basic concepts and its role in decision- making; Linear programming, meaning, scope & assumptions. Formulation of linear programming problem & solution by graphical & Simplex methods. Some special cases like degeneracy, unbounded ness, infeasibility and multiple optimal solutions. Transportation and Assignment models including trans-shipment and routing problems; Some special cases like minimization , unbalanced problems, degeneracy in transportation models. Queuing theory; Inventory management techniques; PERT/CPM; Decision theory and decision trees; Game theory; Simulation.

V - Business Research Methodology

Nature and Scope of Research Methodology, Problem Formulation and Statement of Research, Objectives; Value and Cost of Information; Bayesian Decision Theory; Research Process; Research Designs - Exploratory, Descriptive and Experimental; Methods of Data Collection — Observational and Survey Methods; Questionnaire and Interviews. Attitude Measurement Techniques; Administration of Surveys; Sample Design; Selecting an Appropriate Statistical Technique. Field Work and Tabulation of Data; Analysis of Data; Use of SPSS and other
Statistical Software Packages Advanced Techniques for Data Analysis — ANOVA. Discriminate Analysis, Factor Analysis, Conjoint Analysis and Clustering Methods.

VI - Business Policy and Strategic Management

An Introduction to business policy — Nature, Objective and importance of business policy; An overview of strategic management; Strategic decision making; Process of strategic 4ecision making. Types of planning systems - corporate planning, strategic planning and long range planning; Strategy Formulation, Company's mission, purpose and objectives; Corporate strategy - concept, significance and objectives; types of strategies; Environmental and organizational appraisal (Internal & external) techniques of business environment analysis. Strategic alternatives and

choice; Business ethics and corporate strategy Concept of value chair and competitive advantage. Strategy implementation - Designing organisational structure and activating strategies; Matching structure and activating strategy, Structural, Behavioural and Functional implementation. concept of synergy. Strategy Evaluation - Strategic evaluation and Control, Strategic and Operational Control; techniques of evaluation and control, Role of organisational system in evaluation.

VII - Marketing Management

Nature, scope and concept of marketing, Corporate orientations towards the marketplace; The Marketing environment and Environment scanning; Marketing information system and Marketing research; Understanding consumer and Industrial markets; Market segmentation, Targeting and positioning; Product decisions — product mix, product life cycle, new product development, branding and packaging decisions; Pricing methods and strategies; Promotion decisions— promotion mix, advertising, sales promotion, publicity and personal selling; Channel management - Types and functions, Selection, Cooperation and conflict management, vertical marketing implementation and systems, Marketing Logistics; Organizing and implementing marketing in the organization; Evaluation and control of marketing efforts; Ethics in Marketing; New issues in marketing - Globalization, Consumerism, Green Marketing, Direct Marketing, Network Marketing, Event Marketing.

VIII - Human Resource Management

OB: Personality; Perceptions; Attitudes; Learning; Decision-making; Management by Objectives; Understanding and managing group processes- interpersonal and group dynamics; Applications of Emotional Intelligence in organizations. Leadership and influence process; Work Motivation. Understanding arid Managing organizational system—Organizational design and structure, Work stress, Organizational Change and development; Conflict Management; Stress Management.

HR: Concepts and Perspectives on Human Resource Management; Human Resources Management in a changing environment; Corporate objectives and Human Resource Planning; Career and succession planning; job analysis; Methods of manpower search; Attracting, Selecting and retaining human resources; Induction and socialization; Manpower training and development; Performance appraisal and potential evaluation; Job evaluation and compensation; Employee welfare; Industrial relations & trade unions; Dispute resolution & grievance management, Employee empowerment.

IX - Financial Management

Introduction to financial management Objectives of financial management; Time value of money, sources of finance, Investment decisions: Importance, Difficulties determining cash flows, methods of capital budgeting Risk analysis : Cost of capital; Concept and importance, Computations of cost of various sources of finance; Weighted Average Cost of Capital; Capital Structure decisions; Theories of capital structure, Factors determining capital structure. Optimum capital structure; Management of working capital - Cash, Receivables and Inventory Management, Internal Financing and Dividend Policy; Financial Modelling.

XIII. COMPUTER SCIENCE AND APPLICATIONS

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, Asssignments, 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.
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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.

XIV. Physics

I. Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence. Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

II. Quantum Mechanics

Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wavefunction in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli Exclusion Principle, spin-statistics connection. Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

III. Atomic & Molecular Physics

Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A& B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

IV. Condensed Matter Physics

Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators
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and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

V. Nuclear and Particle Physics

Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

vi. Thermodynamic and Statistical Physics

Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.