AUDISANKARA
(DEEMED TO BE UNIVERSITY)
NH-16, Bypass Road, Gudur-524101, Andhra Pradesh

Syllabus for Entrance Examination for PhD Admissions (ASPAT 2025)

Research Methodology (Common to all branches)

Research formulation and design

Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research.

Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

Data Collection and Analysis

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

Soft Computing

Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

Research Ethics, IPR and Scholarly Publishing

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

Interpretation and Report Writing

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

Department of Computer Science and Engineering

Computer Organization and Architecture

Machine instructions and addressing modes, ALU and data-path, CPU control design, Memory interface, I/O interface (Interrupt and DMA mode), Instruction pipelining, Cache and main memory, Secondary storage.

Programming and Data Structures

Programming in C; Functions, Recursion, Parameter passing, Scope, Binding; Abstract data types, Arrays, Stacks, Queues, Linked Lists, Trees, Binary search trees, Binary heaps.

Algorithms

Analysis, Asymptotic notation, Notions of space and time complexity, Worst and average case analysis; Design: Greedy approach, Dynamic programming, Divide-and-conquer; Tree and graph traversals, Connected components, Spanning trees, Shortest paths; Hashing, Sorting, Searching. Asymptotic analysis (best, worst, average cases) of time and space, upper and lower bounds, Basic concepts of complexity classes – P, NP, NP-hard, NP-complete.

Theory of Computation

Regular languages and finite automata, Context free languages and Push- down automata, Recursively enumerable sets and Turing machines, Undecidability.

Compiler Design

Lexical analysis, Parsing, Syntax directed translation, Runtime environments, Intermediate and target code generation, Basics of code optimization.

Operating System

Processes, Threads, Inter-process communication, Concurrency, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases

ER-model, Relational model (relational algebra, tuple calculus), Database design (integrity constraints, normal forms), Query languages (SQL), File structures (sequential files, indexing, B and B+ trees), Transactions and concurrency control.

Information Systems and Software Engineering

information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project, design, coding, testing, implementation, maintenance.

Computer Networks

ISO/OSI stack, LAN technologies (Ethernet, Token ring), Flow and error control techniques, Routing algorithms, Congestion control, TCP/UDP and sockets, IP(v4), Application layer protocols (icmp, dns, smtp, pop, ftp, http); Basic concepts of hubs, switches, gateways, and routers. Network security – basic concepts of public key and private key cryptography, digital signature, firewalls.

Web technologies

HTML, XML, basic concepts of client-server computing.

Department of Electronics and Communication Engineering

Electronics and Communication Systems

Baseband Data Transmission: Signal and Systems, probability and Random variables, Digital Electronics, Microprocessor, Spread Spectrum Signals for Digital.
Communication: Model of Spread Spectrum Digital Communication System – Direct Sequence Spread Spectrum Signals – Error Rate Performance of the Decoder, Some Applications of DS Spread Spectrum Signals, Generation of PN Sequences – Frequency Hopped Spread Spectrum Signals – Performance of FH Spread Spectrum Signals in an AWGN Channel, CDMA System Based on FH Spread Spectrum Signals.

Fiber Optic Communication

Optical fiber waveguides: Transmission Characteristics of Optical Fibers: Attenuation. Material absorption losses in silca glass fibers: Intrinsic absorption, Extrinsic absorption. Linear Scattering Losses: Rayleigh Scattering, Mie scattering.

Non-Linear Scattering Losses: Stimulated Brillouin Scattering, Stimulated Raman Scattering. Fiber bend loss, Core and Cladding losses. Dispersion: Intramodal Dispersion: Material and Waveguide Dispersion. Intermodal Dispersion: Multimode Step index Fiber, Multi-Mode Graded Index Fiber.

Semiconductor photodiodes without Internal gain: p-i-n photodiode. Semiconductor photodiodes with Internal gain: Avalanche Photodiodes. Photo conductive Detectors, Photo Detector Noise: Noise Sources, Signal-to-Noise Ratio.

Optical fiber systems: The Optical Receiver Circuit: Fundamental Optical Receiver Operation. Digital system Planning Considerations: The Regenerative Repeater, Channel Losses.
Optical Power Budgeting: Link Power Budget, Rise time Budget, Line Coding.

Demodulation schemes: Heterodyne Synchronous Detection, Heterodyne non- synchronous detection, Homodyne detection. Receiver sensitivities.

Micro Wave Engineering

Microwave tubes: Limitations of Conventional tubes at Microwave frequencies, Klystron: Velocity – modulation process. Bunching process, output power and beam loading, Multicavity Klystron amplifiers: beam current density, output current and output power of two cavity Klystron, reflex Klystron, Velocity modulation, Power output and efficiency. Traveling Wave tubes, Microwave crossed field tubes: Cylindrical Magnetron, CFA and BWO.

Microwave passive components: Wave guide bends and twists, wave guide Tees, Tee junction parameters, fields and currents in tee junctions, theorems on Tee junctions, shunt or H-plane tee, series of E-plane Tee, Equivalent circuit of magic tee, applications of magic tee. Directional couplers, coupler parameters, directional couplers in use, applications of directional couplers,

Ferrite Devices, Faraday Rotation Isolator, Circulator, Gyrator (elementary principles only), Attenuators, microwave resonators, rectangular and cylindrical cavity resonators.

Microwave solid-state devices: Microwave tunnel diode, Avalanche transit time diodes: Read diode, IMPATT diode, TRAPATT diode, GUNN effect diodes and modes of operation, Pin diodes, Varactor diodes, Crystal detectors. BARITT Diode.

Microwave integrated CIRCUITS: Salient Features of MICS, types of Electronic Circuits, MMIC, HIC, FIC, QMIC, MMIC materials, Methods of MMIC Fabrication, Steps involved in Fabrication, Transmission lines in MICS, Fabrication of MOSFETS in MMICS, Fabrication of CMOS, fabrication of passive components

Radar System Engineering

Operational characteristics of radar: Radar Frequencies, Pulsed Operation, Pulse Repetition Frequency, Radar Range Equation, Minimum Detectable Signal, Receiver Noise, Signal to Noise Ratio, Integration of Radar Pulses, Radar Cross Section, Propagation Losses.

Radar systems: Principles and Block diagrams of Pulse Radar, CW Radar, FM- CW Radar, MTI Radar, Non-Coherent MTI Radar, Doppler Radar, Tracking Radar, Synthetic Aperture Radar.

Detection of radar signals: Matched Filter Receiver, Correlation Detection, Likelihood Function, Detector Characteristics, Inverse probability, Optimum Design Criteria, Binary Integrators, Delay-Line Integrators.

Target parameter estimation: Statistical Estimation of Parameters, Maximum Likelihood Estimation, Theoretical Accuracy of Range and Doppler Velocity Measurements, Uncertainty Relation, Angular Accuracy, Ambiguity Function and Radar Transmitter waveform Design, Pulse Compression Radar.

Antennas

Aperture type antennas :Radiation form a planar Aperture : The Fourier Transform Method, Rectangular and Circular Apertures, Uniform Aperture Field with a Linear Phase Variation, Tapered Aperture Field, Field –Equivalence Principles, Application of Field Equivalence Principles to Pyramidal Horns.ANTENNA TYPES : Principles of reflector Antennas, Lens Antennas and array Antennas – A Comparative study, Dual reflector systems, Theory of images, Radomes-principle and design considerations.ARRAY ANTENNAS:N-Element Linear Array : Broadside Array, Ordinary End-fire Array, Hansen-Woodyard End-Fire Array.N-Element Linear Array : Uniform spacing, Nonuniform Amplitude Array Factor, Binomial Array, Dolph – Tschebyscheff Array,Planar Array : Array Factor, Beam Width, Directivity, Design Considerations.Circular Array:Concept of superdirective Array (SDA), ARRAY

Synthesis: Discretization of continuous source : Schelkunoff polynomial Method, Fourier Transform Method, Woodward-Lawson Method.Linear Array Design Procedures : Taylor Line source (Tschebyshceff Error), Taylor Line – Source (One – Parameter)

Satellite Communication

Multiple access techniques: FDM / FM Satellite Systems, FDMA: SPADE
DAMA Satellite System, TDMA CEPT primary Multiplex frame, CDMA: Encoder, decoder,

Comparison between CDMA, FDMA & TDMA.

Satellite link design: Basic transmission theory, System noise temperature and G / T ratio. Design of uplink and down link models, Design of Satellite links for specified C / N ratio.

Spread spectrum techniques: PN Sequences, Notion of Spread Spectrum, DSSS: DSSS with CBPSK, Processing gain, Probability of error, Acquisition and tracking, FHSS: Slow frequency hopping, Fast frequency hopping. Acquisition and tracking, Practical Jammer types,
Satellite packet communications: Message transmission by FDMA: The M/G/1 Queue, Message Transmission by TDMA – Pure ALOHA: Satellite packer switching – slotted ALOHA – Packet Reservation – Tree algorithm.

Department of Electrical and Electronics Engineering

Electric Circuits and Fields

Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's and Superposition and Maximum Power Transfer theorems, two-port networks, three phase circuits; Gauss Theorem, electric field and potential due to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

Electrical Machines

Single phase transformer - equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers - connections, parallel operation; auto-transformer; energy conversion principles; DC machines - types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; three phase induction motors - principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines - performance, regulation and parallel operation of generators, motor starting, characteristics and applications; servo and stepper motors.

Power Systems

Basic power generation concepts; transmission line models and performance; cable performance, insulation; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow; voltage control; power factor correction; economic operation; symmetrical components; fault analysis; principles of over-current, differential and distance protection; solid state relays and digital protection; circuit breakers; system stability concepts, swing curves and equal area criterion; HVDC transmission and FACTS concepts.

Control Systems

Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Niquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

Electrical and Electronic Measurements

Bridges and potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; instrument transformers; digital voltmeters and multimeters; phase, time and frequency measurement; Q-meters; oscilloscopes; potentiometric recorders; error analysis.

Power Electronics and Drives

Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters - fully controlled and half controlled; principles of choppers and inverters; basis concepts of adjustable speed dc and ac drives.

Department of Civil Engineering

Structural Engineering

Mechanics: Bending moment and shear force in statically determinate beams. Simple stress and strain relationship: Stress and strain in two dimensions, principal stresses, stress transformation, Mohr's circle. Simple bending theory, flexural and shear stresses, unsymmetrical bending, shear centre. Thin-walled pressure vessels, uniform torsion, buckling of column, combined and direct bending stresses.

Structural Analysis: Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/ energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

Concrete Structures: Concrete Technology- properties of concrete, basics of mix design. Concrete design- basic working stress and limit state design concepts, analysis of ultimate load capacity and design of members subjected to flexure, shear, compression and torsion by limit state methods. Basic elements of pre-stressed concrete, analysis of beam sections at transfer and service loads.

Steel Structures: Analysis and design of tension and compression members, beams and beam-columns, column bases. Connections- simple and eccentric, beam–column connections, plate girders and trusses. Plastic analysis of beams and frames.

Water Resources Engineering

Fluid Mechanics and Hydraulics: Properties of fluids, principle of conservation of mass, momentum, energy and corresponding equations, potential flow, applications of momentum and Bernoulli's equation, laminar and turbulent flow, flow in pipes, pipe networks. Concept of boundary layer and its growth. Uniform flow, critical flow and gradually varied flow in channels, specific energy concept, hydraulic jump. Forces on immersed bodies, flow measurements in channels, tanks and pipes. Dimensional analysis and hydraulic modeling. Kinematics of flow, velocity triangles and specific speed of pumps and turbines.

Hydrology: Hydrologic cycle, rainfall, evaporation, infiltration, stage discharge relationships, unit hydrographs, flood estimation, reservoir capacity, reservoir and channel routing. Well hydraulics. Irrigation: Duty, delta, estimation of evapo- transpiration. Crop water requirements. Design of: lined and unlined canals, waterways, head works, gravity dams and spillways. Design of weirs on permeable foundations. Types of irrigation system, irrigation methods.

Environmental Engineering

Water requirements: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

Soil Mechanics

Soil Mechanics: Origin of soils, soil classification, three - phase system, fundamental definitions, relationship and interrelationships, permeability and seepage, effective stress principle, consolidation, compaction, shear strength.

Transportation Engineering

Highway Planning: Geometric design of highways, testing and specifications of paving materials, design of flexible and rigid pavements.

Traffic Engineering: Traffic characteristics, theory of traffic flow, intersection design, traffic signs and signal design, highway capacity.

Department of Mechanical Engineering

Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr’s circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler’s theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

Theory of Machines: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts, Vehicle Dynamics

Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the

S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs, automatic transmission.

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes, bends and fittings. Flow separation, introduction to turbulence, transition, structure of a turbulent boundary layer.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.

Applications: Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and dual cycles. Refrigeration and air- conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines. Thermodynamics of Aircraft Gas Turbine engines.

Alternative fuels: Estimate of petroleum reserve, properties of alternate fuels, CNG, LPG, Alcohol, Vegetable oil, Bio-gas, ethanol and hydrogen - Production methods, storage and handling, safety aspects.

Materials, Manufacturing and Industrial Engineering

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials, powder metallurgy, composite materials.

Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

Machining and Machine Tool Operations: Mechanics of machining; basic machine tools; single

and multi-point cutting tools, tool geometry and materials, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, design of jigs and fixtures.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning, Inventory Control, Operations Research.

Department of Computer Applications

Software Engineering

Software Engineering: Role of Software, Changing Nature of Software, Legacy Software, Software Myths.

A Generic View of Process: Software Engineering - A Layered Technology, A Process Framework, The CMMI, Process Patterns, Process Assessment, Personal and Team Process Models, Process Technology, Product and Process.

Process Models: Prescriptive Models, the Waterfall Model, Incremental Process Models, Evolutionary Models, Specialized Process Models.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating the Requirements Engineering Process, Eliciting Requirements, Negotiating Requirements, Validating Requirements.

Building the Analysis Model: Requirements Analysis, Analysis Modeling Approaches, Data Modeling Concepts, Flow-Oriented Modeling, Creating a Behavioral Model and unified modeling approaches.

Design Engineering: Creating An Architectural & Component Level Design, Performing User Interface Design.

Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies include Conventional Software, Test Strategies for Object-Oriented Software, validation testing, system testing, Art of Debugging.

Testing Tactics: Software Testing Fundamentals, Black-Box and White-Box Testing, White-Box Testing, Basis Path Testing, Control Structure Testing, Black- Box Testing, Object-Oriented Testing Methods, Testing Methods Applicable at the Class Level, Interclass Test Case Design, Testing for Specialized Environments, Architectures, and Applications, Testing Patterns.

Database Management and Systems

Database Fundamentals: basics of database systems, including data models (e.g., relational, hierarchical, network), database design, query languages (e.g., SQL), and transaction processing. Data Modeling: entity-relationship (ER) modeling, object- oriented modeling, and semantic data modeling. Query Processing and Optimization: query parsing, query optimization algorithms,

and query execution. Database Administration: user management, security, backup and recovery, and performance tuning. parallel databases, data warehousing, data mining, and big data.

Computer Networks

Reference models, Physical Layer, Multiple access protocols, Ethernet, Routing algorithms, Congestion control algorithms, Quality of service, Internet working, Network layer in the Internet, Transport service, Elements of transport protocols, Internet transport protocols: TCP & UDP, Domain Name System

Operating Systems

System Software and Operating Systems: Understanding the role of OS within the system software hierarchy, its core functionalities like process management, memory management, device management, file management, and security.

Computer Architecture: Grasping the underlying hardware architecture, including memory hierarchy (cache, main memory, secondary storage), CPU organization, and I/O systems.

Concurrent Processes: Mechanisms for handling multiple processes executing concurrently, including synchronization primitives (semaphores, monitors), inter-process communication (pipes, message queues), and scheduling algorithms.

Department of Management Studies

Principles of Management

Fayol's Principles of Management; Functions of Management; Skills of a Manager; Social Responsibility; Planning types and process; Management by Objectives; Decision-making tools; Formal and informal organizing; Process of Organising; Departmentation; Span of Control; Line and Staff concepts; Delegation of Authority; Decentralisation; Staffing; Assumptions of Human Behaviour; Theories of Motivation; Leadership Styles; Controlling process; Control techniques; Understanding work teams; Managing Innovation; Managerial Values; Technology and Management; Culture and Management.

Human Resource Management

Importance and Functions, Scope of HRM; Human Resource Management in a changing environment; Manpower Planning: Manpower planning process, Job Description and Job specification, Job analysis and Job design; Techniques of Job design; Employee Selection and Development - Recruitment, Selection and Induction, Training and Development, Performance Appraisal; Compensation Planning- Employee Compensation, Job evaluation, Employee Benefits and Welfare, Compensation and Salary Administration; Integration and Separation- Employee Discipline, Suspension, Dismissal and Retrenchment. Employee Grievance Handling, Trade Unionism, Collective Bargaining, Industrial Democracy.

Marketing Management

Need, Want and Demand; Marketing; Marketing Orientations; Marketing Environment; Buyer Behaviour; Marketing Planning Process; Consumer value and satisfaction; Identification and Analysis of Competitors; Market Segmentation, Targeting and Positioning strategies; Marketing

Mix; The product; New Product Development; Product Life Cycle; Product Mix decisions; Branding; Packaging and Labeling; Pricing Decisions; Factors influencing Price – five "C"s; Pricing Strategies; Distribution Decisions; Managing promotion Mix; Advertising, Personal selling, Sales Promotion and publicity, Integrated Marketing Communication; Marketing Control techniques; Social Marketing; Green Marketing; Web Marketing

Financial Management

Nature and Scope of Financial Management- Goals & objectives of financial management, Role of Financial Manager -Concept of time value of money; Sources of long term and short term financing, Overview of Indian Stock Markets; Capital Budgeting decisions: NPV- IRR - Risk analysis in capital budgeting. RADR, certainty equivalent, decision tree analysis; Capital structure decisions: capital structure theories -EBIT &EPS analysis – financial Leverage- Operating leverage - Cost of capital and WACC; Dividend decisions: dividend models - dividend theories - Working capital - cash Management - Inventory Management – Receivables management.

Organizational Behavior

Organizational Behavior – Emergence of OB as a discipline: Contributing Disciplines to the OB field; Nature and Scope of OB; Significance of OB; Challenges and Opportunities for OB; Foundations of Individual Behavior: Personality- Personality determinants; Personality traits: The Big Five Model; Theories of personality; Learning- Theories of learning; Principles of learning; Attitudes – Source of attitudes; Types of Attitudes; Perception- Perceptual process; Factors influencing Perception; perceptual distortion; Foundations of Group Behavior: Groups Types of groups; Stages of Group Development; Group Decision-Making; Leadership – Nature; Theories of leadership; Conflict Management; Organizational Culture and Change Management.

Operations Management

Functions of operations manager; Types of production processes and their suitability; Just-in-time production; manufacturing operations versus service operations; Steps/levels in production planning and control; Strategic planning, aggregate planning, shop-floor planning; Planning devices – Gantt Chart, Master production schedule, PERT/CPM; Factors influencing facility location decision; Location modeling; Factors influencing layout decision; Facility layout modeling; types of material handling equipment and their purposes; Factors affecting productivity; Job design; Work study; Work measurement; Ergonomics; Kaisen; Costs associated with inventory; Economic order quantity; Acceptance sampling; Control charts; Six sigma; TQM.

Strategic Management

Basic Concepts of Strategic Management; Basic model and the process of strategic management; Business Vision, Mission and Objectives; Contents and characteristics of corporate Mission Statements; Environment and Resources Analysis: Environmental analysis, Industry and Competitive Analysis, Porter's Five Forces Model, Internal Analyiss, SWOT Analysis, Value Chain Analysis; Strategy Formulation; Types of strategies; Michael Porter's Generic Business strategies, Ansoff's Product-Market Matrix; Strategic Choice: Strategic Analysis and Choice; Portfolio analysis and its limitation; BCG matrix and GE nine-cell matrix; Strategic

Implementation and Control: Issues in implementation;

Managerial Economics

Economics and managerial decision making; Managerial Economics, Nature and scope of Managerial Economics; Tools of Managerial Economics; The firm and its goals; The Nature of profits; Role of a Managerial Economist; Demand and Supply Analysis: Concept of demand, Determinants of demand, Law of Demand; Law of supply; Elasticity of demand, Types of Elasticity of demand, Demand estimation and demand forecasting; Production and Cost Analysis: Production functions; Optimum input combination; Cost concepts, Cost curves, Economies of Scale; Markets, Kinds of Competition; Features of different types of market structures, Price & Output determination under Perfect competition, Monopoly, Monopolistic competition, Oligopoly; Macroeconomic concepts: National Income, Measurement of National Income; Business Cycles, Stages of business cycles; Inflation, Types of Inflation; Measures to overcome Inflation

Department of Mathematics

Analysis

Matrices spaces, open sets, closed sets, compact sets in the Euclidean space IR^n, complete metric space, diameter of a set-in metric space, convergence of a sequence in a metric space, sequences and series of a number.

Continuity of a function, Continuity and compactness, Continuity and connectedness, intermediate value theorem, discontinuous of real valued functions on a subset of R , monotone functions, infinite limits and limits at infinity.

Differentiation – mean value theorems, higher derivatives, Taylors theorem, continuity of derivatives, L'Hôpital's rule, differentiation of vector valued functions.

Riemann Stilye's integral-definition and existence, integration and differentiation, rectifiable curves, uniform convergence of sequences and series of function- Continuity, derivative and integration.

Topology

Metric Spaces: Open sets, closed sets, convergence, Continuity, Baire's theorem, spaces of Continuous functions, Euclidean and unitary spaces.

Topological spaces: Elementary concepts, bases and subbases, weak topologies, compactness, product spaces, Tychnoff theorem, Ascoli's theorem, connectedness, components.

Separation: T1 spaces, Hausdraff spaces, regular spaces, normal spaces, completely regular spaces, Urysahon's lemma, Urysahon's embedding lemma and Tietje extension, extension theorems.

Algebra

Groups: Automorphisms, conjugacy, cosets, normal series, sylow theorems, solvability, cyclic decomposition, simplicity of A_n. Direct products, finitely generated abelian groups, invariance of a finite abelian group, groups of order p^n and p^q.

Rings: Ideals and homomorphisms, sum and direct sum of ideal, prime ideals , maximal ideal, nilpotent and nil ideals. Unique factorization domain, principal ideal domain, Euclidean domain, polynomial ring over UFD, rings of fractions.

Complex Analysis

Analytical functions: Cauchy – Riemann equations, conformal mapping- Bilinear mapping-power series. Complex integration – Cauchy's theorem – Integral Formula Morera's theorem-Lawrent series – Maximum modulus theorem – Livoulli's theorem.

Classification of singularities – Calculus of residues, number of zeros and poles – Rouche's theorem. Evaluation of integral using calculus of residues.

Applied Mathematics

Fourier series, even and odd functions, Parseval's inequality, complex form of Fourier series, Harmonic analysis, Applications to engineering situations.

Fourier Transforms, Fourier integral theorem, Fourier sine and cosine transform, finite Fourier transforms, transforms for derivatives, Applications for solving partial differential equations.

Ordinary differential equations, Methods of Solutions, Physical applications, partial differential equations, methods of solutions, Physical applications.

Laplace Transforms, properties, Inverse Laplace Transforms, convolution theorem, Applications to solve ODE and PDE.

Numerical solutions of algebraic and transcendental equations, solutions of simultaneous equations, numerical solutions of Ordinary differential equations by Picards, Eulers, modified Eulers and R – K methods, Numerical solutions of Laplace and Poisson equations, numerical integration by trapezoidal, Simpson's methods.

Probability

Basic concepts of theory of probability, Baye's theorem, probability distributions, Binomial distributions, Poisson distributions, Maueut generating functions, Poisson process, continuous uniform distributions, Normal distribution, Exponential distributions, Gamma distribution, Weibull distributions and their basic properties.

Department of English

1. Chaucer to Shakespeare
2. Romantic Period
3. Victorian Period
4. Modern Period
5. Contemporary Period
6. History of English Language
7. English Language Teaching
8. Indian Writing in English

9. Indian Literature in English Translation
10. Contemporary British literature
11. Modern British Literature
12. American and other non-British English Literature
13. Contemporary Theory
14. Literary Theory and Criticism

Department of Physics

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.

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.

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.

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 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.

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.

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.

Department of Chemistry

Physical and theoretical Chemistry

Atomic structure: Bohr’s model – results of wave mechanical model – quantum numbers – shapes of orbitals.

Chemical kinetics and equilibrium: Rates of reactions – 1^{st} and 2^{nd} order reactions – activation energy – K_p, K_x, K_n, etc. Homogeneous chemical equilibria – acids and bases – pK_a of acid – solubility product.

Thermodynamics and thermo chemistry: Isothermal and adiabatic processes – Carnot cycle, First, second and third laws of thermodynamics and their applications, entropy – free energy and chemical potential – chemical equilibria – phase equilibria, C_v and C_p, Hess law – Kirchoff’s law – surface chemistry and thermodynamics – adsorption – solid state chemistry with reference to adsorption – solution chemistry – colligative properties – solvation – polar solvents.

Chemical Dynamics: Kinetic theory of gases – kinetics of reactions in the gas phase – theories of reactions – collision theory – transition state theory – applications of thermodynamic concepts to reactions – complex reactions such as parallel, consecutive and reversible reactions – chain reactions and their kinetics – kinetics in the liquid phase – effect of medium on reactions –

homogeneous and heterogeneous catalysis – photochemistry in the gas phase and in solution – fluorescence – mechanism of photochemical reactions – irreversible processes in solution – fast reactions - viscosity – diffusion – sedimentation – behaviour of large molecules in solution – surfactants and their properties.

Electrochemistry: Conductance of electrolytes – transference – cells, half cells – Nernst equation – simple applications of conductivity and potentiometry Electrochemical cells – Nernst equation – theory of strong electrolytes (Debye- Huckel theory) – electrical double layer Lippman equation and structure – electrokinetic phenomena – basic electrode kinetics – Butler Volmer equation – Tafel equation – electroanalytical techniques (e.g. polarography etc.)

Quantum chemistry and Chemical bonding: Schrodinger equation (SE) - postulates of quantum mechanics – operators – operators (Hamiltonian, angular momentum, spin and ladder) – exact solution of SE for some systems e.g. Particle in the box, rigid rotor harmonic oscillator – approximate methods, variations and perturbation methods – LCAO – MO and VB methods. MO of diatomics and correlation diagrams – Huckel MO (HMO) theory and application to simple systems (e.g. conjugated polyenes etc.) hybrid orbitals, molecular geometry.

Nuclear Chemistry: Nuclear reactions – fission and fusion – Radioactive decay process – interaction of radiation with matter.

Spectroscopy: UV-Vis, IR, Raman spectroscopy – principles of NMR and ESR spectroscopy – spin – spin splitting – hyperfine interactions – fundamental understanding of ESCA and Moss Bauer spectroscopy - theories of the above spectroscopies with quantum mechanical approach – applications.

Inorganic and Analytical Chemistry

Analytical Chemistry: Principles of volumetric and gravimetric analysis, organic reagents in inorganic analysis, Principles of Instrumental methods in analysis – neutron activation, isotope solution analysis, spectrophotometry and flame photometry, general applications of instrumental methods of chemical analysis – electrochemical and spectroscopic methods in analytical chemistry.

Chemistry of main group elements: A comparative account of the Chemistry of alkali, alkaline earth metals, non-transition elements and rare gases.

Solid State Chemistry: Crystal systems, Bravais crystal system, crystal symmetry, symmetry elements in a cubic system, laws of crystallography, atomic radius, number of atoms per unit cell, atomic packing factor, Weiss and Miller indices, interplanar spacing, X-ray studies of crystals-Bragg's equation, imperfections in crystals, structure of CsCl, CaF_2, TiO_2, diamond and graphite, electronic properties of solids, band theory.

Synthetic Inorganic Chemistry: Synthesis, principles and structures of the following compounds, boron hydrides, boron anions, carboranes, compounds having B-N, B-P, Si-O, P-N, S-N, metal-hydrogen and metal carbon bonds – noble gas compounds.

Coordination compounds and transition metals: Coordination number – nomenclature – measurement of stability constants of complexes – mono and polyligated systems. Coordination components, isomerism, Principles of VB, MO and LF approaches, eleectronic spectrum and magnetic properties. Reaction mechanism of square planar and octahedral complexes. dn

configurations and their theoretical analysis R – S states – CF and LF theories – state splitting in different fields. Electronic spectra of complexes. Lanthanides – their properties – spectral and magnetic properties of lanthanides and transition and metal complexes.

Organo-Metallics: Metal carbonyls – olefin and acetylene complexes – metallocenes – haemoglobin.

Organic Chemistry

Reaction Mechanism: Chemical bonding and structure – nucleophilic substitution reactions at saturated carbon atoms – neighboring group participation – carbonium ion rearrangements – mechanisms of oxidation of alcohols and ketone reductions. Elementary treatment of reaction of type S_N1, S_N2, E1 and E2. Hoffmann and Saytzeff Rules – substitutions at the aromatic ring, electrophilic, nucleophilic and radical – correlation of structure and reactivity – inductive, resonance and steric effects.

Reactions: Cycle additions – hydroboration – Hunsdiecker, Dieckmann, reactions, Cope, Fries and Claisen rearrangements and their mechanism – electron deficient carbon and nitrogen mediated rearrangements – Witting, Wolff, Hoffmann, Curtius, Schmidt reactions – Mannich, Favorski, Michael, Robinson reactions – enolates and enamines.

Reagents used in organic synthesis (like $KMnO_4$, $K_2Cr_2O_7$, $LiAlH_4$, $NaBH_4$, Wilkinson's catalyst, DCC, etc.)

Organic Photo Chemistry: Reactions of carbonyl compounds – dienes, cycloadditions – Woodward –Hoffmann rules – applications.

Terpenes: Classification – syntheses – structural elucidation of mono terpenoid and diterpenoids.

Steroids: Classification – rearrangements of steroids – photo chemical transformations – Barton reaction – cholesterol – synthesis of aromatic steroids.

Structural Elucidation by Spectroscopic Methods: Application of UV, IR and NMR spectroscopy to structural analysis of organic compounds.

IUPAC system of nomenclature, alkanes, alkenes, dienes, ketones, alcohols, amines and carboxylic acids – their preparation and properties. Aromaticity and benzene chemistry.

Stereo Chemistry: Optical activity – asymmetric synthesis – conformational analysis of cyclohexanes and decalines – octat rule. Cyclohexane – Conformational analysis geometric isomerism concepts of Z and E, R and S notations.

Heterocyclic compounds: Preparation, properties of Thiophene and pyrrole.