



**UNIVERSITY OF ENGINEERING &
MANAGEMENT, JAIPUR**

**Syllabus and Pattern For Ph. D.
Entrance Exam**

PH.D. PROGRAMMES OFFERED IN THE FOLLOWING DEPARTMENTS / SCHOOLS

1. Engineering

- Civil Engineering (CE)
- Computer Applications
- Computer Science & Engineering (CSE)
- Electronics & Communication Engineering (ECE)
- Electrical Engineering (EE)
- Mechanical Engineering (ME)

2. Basic Sciences & Humanities

- Chemistry
- English & Humanities
- Mathematics
- Physics

3. School of Management

4. School of Physiotherapy

PATTERN FOR Ph.D. ENTRANCE EXAMINATION

Section-1: 35 Questions from Research Methodology (Common for All Departments)

Section-2: 35 Questions from Subject-Specific Paper

Syllabus for Entrance Examination

Research Methodology (Common for All Departments)

Research Aptitude: Research: Meaning, Research Problem, Research Objectives, characteristics and types: Fundamental, Applied, Action, Quantitative/Qualitative Steps of research; Methods of research; Research Problem: Identification of Research Problem, Defining Research Problem, Literature Review: Primary Sources, Secondary Sources, Searching e-resources, Searching Databases, Writing literature review, Research Methodology: Survey method, Experimental Method, Historical Method, Content Analysis, Hypothesis: Meaning, Types of Hypothesis, Formulation of Hypothesis,

Research Ethics: Paper, article, workshop, seminar, conference and symposium; Thesis writing; its characteristics and format, Copyright, Plagiarism, Originality of research work

Reasoning (Including Mathematical): Number series; letter series; codes; Relationships; classification.

Logical Reasoning: Understanding the structure of arguments; Evaluating and distinguishing deductive and inductive reasoning; Verbal analogies; Word analogy – Applied analogy; Verbal classification; Reasoning Logical Diagrams: Simple diagrammatic relationship, multi diagrammatic relationship; Venn diagram; Analytical Reasoning.

Data Interpretation: Sources, acquisition and interpretation of data; Quantitative and qualitative data; Graphical representation and mapping of data.

Communication: Nature, Characteristics and Types; Barriers; Effective classroom communication; Non-verbal communication

COMPUTER SCIENCE & ENGINEERING (CSE)

Set Theory & Algebra: Sets; Relations; Functions; Groups; Partial Orders; Lattice; Boolean Algebra. Digital Logic: Logic functions, Minimization, Design and synthesis of combinational and sequential circuits; Number representation.

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, 8085 microprocessor.

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

Algorithms: Divide & conquer, Branch & bound, Dynamic programming, Greedy techniques, NP-Hard & NP Complete.

Theory of Computation: Regular languages and finite automata, Context free languages and Push-down automata

Compiler Design: Lexical analysis, Parsing, Syntax directed translation

Operating Systems: Processes, Threads, Interprocess communication, Concurrency, Semaphores, Synchronization, Deadlock, CPU scheduling, Memory management and virtual memory, File systems, I/O systems, Protection and security.

Databases: ER-model, Database design (integrity constraints, normal forms), Query languages (SQL).

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), Flow and error control techniques, TCP/UDP and sockets, IP(v4), Application layer protocols, Basic concepts of hubs, switches, gateways, and routers. Network security – basic concepts of public key and private key cryptography, digital signature, firewa

ELECTRONICS & COMMUNICATION ENGINEERING (ECE)

Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices.

Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers, PN junction diode, Simple diode circuits, clipping, clamping, rectifier, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, PIN and avalanche photo diode, Basics of LASERs. Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. CMOS Inverter & its characteristics, Biasing and bias stability of transistor; FET amplifiers.

Boolean algebra, minimization of Boolean functions; logic gates; CMOS logic & other logic families, Fundamental considerations of CMOS fabrication process.

Definitions and properties of Laplace transform continuous-time and discrete time Fourier series, continuous-time and discrete-time Fourier Transform.

Digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), TDMA, FDMA and CDMA and GSM.

Elements of vector calculus: divergence and curl; Gauss' and Stokes' theorems, Maxwell's equations: differential and integral forms, wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth. Transmission lines: characteristic impedance; impedance transformation; Smith chart; impedance matching; S parameters, pulse excitation.

Waveguides: modes in rectangular waveguides; boundary conditions; cut-off frequencies; dispersion relations. Basics of propagation in dielectric waveguide and optical fibers.

Basics of Antennas: parameters, array antennas, Measurements. Frequency band, microwave components, TWT, Gun diode, different types of radar, radar antennas, radar range equation.

ELECTRICAL ENGINEERING (EE)

Electric Circuits and Networks: Network graph, Node and Mesh analysis, Transient response of DC and AC networks, Time Domain & Frequency Domain Analysis using Laplace and Fourier Transformations. Network Theorems: Thevenin's, Norton's, Superposition and Maximum Power Transfer Theorems, Star-Delta Transformations, Source Transformation. Analysis of Two-port networks: H, Y, Z and ABCD parameters representations. Magnetic Circuits. Single phase and Three phase circuits.

Power Systems: Basic concepts of Generation, Transmission and Distribution of Electrical Power, Models and Representation of Power System components: Synchronous Machines, Transformers, Transmission Lines etc. Per Unit Representations, Symmetrical Components, Fault Analysis (LG, LLG, LL, LLLG faults), Bus impedance and Admittance Matrices, Load Flow Analysis and Solution Techniques, Voltage Control, Reactive Power Compensation and Power Factor Correction, Economic Operation, Power System Stability – Angle and Voltage Stability, HVDC Transmission and FACTS Devices, Protection Systems - Relays and Circuit Breakers.

Electrical Machines: Single and Three Phase Transformer – Equivalent circuit, Phasor diagram, tests, regulation and efficiency, parallel operation; Auto-transformer; Energy conversion principles; DC machines – types, windings, generator characteristics, armature reaction and commutation, starting and speed control of motors; Single & Three Phase Induction Motors – principles, types, performance characteristics, starting and speed control; Synchronous Machines – construction, performance, regulation and parallel operation of generators, motor starting, characteristics and applications.

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.

Control Systems: Principles of Open Loop and Feedback; Transfer Function; Block Diagrams; Steady-State Errors; Routh and Nyquist Techniques; Bode Plots; Root loci; Lag, Lead and Lead-lag compensation; State Space Model; State Transition Matrix, Controllability and Observability.

Signals and Systems: Representation of continuous and discrete-time signals; shifting and scaling operations; Linear, Time-invariant and causal systems; Fourier series representation of continuous periodic signals; Sampling Theorem; Fourier, Laplace and Z transforms.

Engineering Mathematics: Matrix Algebra, Vector Calculus, Fourier series, Differential equations - linear and nonlinear. Partial Differential Equations, Probability and Statistics, Numerical Methods - Solutions of Non-linear algebraic equations, single and multi-step methods for differential equations. Transform Theory - Fourier transform, Laplace transform, Z-transform.

MECHANICAL ENGINEERING (ME)

Metal Casting: Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations.

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk and sheet metal forming processes; principles of powder metallurgy. **Joining:** Physics of welding, brazing and soldering; adhesive bonding; design considerations in welding.

Machining and Machine Tool Operations: Mechanics of machining, single and multi-point cutting tools, tool geometry and materials.

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy; fluid kinematics: Lagrangian and Eulerian description, Reynolds transport theorem, Conservation Laws: control-volume analysis of mass, momentum and energy; Bernoulli's equation, viscous flow of incompressible fluids), Dimensional analysis and similarity, Ideal flow, laminar flow, boundary layer; elementary turbulent flow; flow through pipes, Compressible flow.

Heat-Transfer: **Heat Conduction:** Steady state heat conduction, Transient heat conduction, Numerical solution to heat conduction, **Convection** Heat transfer: Forced convection, Free convection and Mixed convection, Boiling and Condensation, Thermal radiation, radiation from black body, radiation properties of real bodies, Radiative exchange between surfaces, Heat exchanger design and analysis, LMTD and NTU methods, Melting and solidification.

Thermodynamics: thermodynamic system and processes; phase diagrams, Laws of Thermodynamics, Temperature scales, Irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, Cycle analysis, Carnot cycle, Rankine cycle, Air standard cycles, refrigeration and heat pump cycles, analysis of thermodynamic cycles related to energy conversion. **Engineering Mechanics:** Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, **Strength of Materials:** Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; **Theory of Machines:** Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels. **Production Planning and Control:** Forecasting models, aggregate production planning, scheduling, materials requirement planning. **Inventory Control** deterministic & probabilistic models; safety stock inventory control systems. **Operations Research:** Linear programming, simplex and graphical method, transportation model, assignment model, network flow models, simple queuing models, PERT and CPM. **Supply Chain Management.** **Numerical Methods for Engineers:** Solution of a system of linear algebraic equations, direct and iterative methods for matrix inversion, numerical solution of ODE, Taylor series expansion, Errors.

CIVIL ENGINEERING (CE)

Structural Analysis: Shear force and bending moment, Simple stresses and strains, Shear stresses in beams, Principal stresses and strains, Direct and bending stresses, Columns and struts, Analysis of determinate and indeterminate structures, Moving load, influence lines, Strain energy, Three hinged arches.

Design of Reinforced Concrete and Steel Structures: Cement, Aggregates, Water, Admixtures, Fresh concrete, Properties of hardened concrete, Strength porosity relationship, Durability of concrete and its significance, Concrete mix design, Limit state of collapse, Limit state of serviceability, Design of flexural and compression members, Connections-simple and eccentric, Plastic analysis of beams and frames.

Fluid Mechanics and Hydrology: Fluid statics, Pascal law, Hydrostatic law, Pressure measurements, Buoyancy & floatation, Fluid kinematics, Fluid dynamics, Flow measurement: Orifices, Mouth pieces, Notches, Weirs, Flow through pipes, Dimensional analysis and Models, Laminar flow, Turbulent flow in pipes, Boundary layer theory, Open channel flow, Varied flow, Bernoulli's equation. Hydrology, Hydrologic cycle, Scope and applications of hydrological cycle, Precipitations types and measurement, Evapo-transpiration, Consumptive use, infiltration and percolation, Measurement and analysis of runoff data, Hydrographs, Mass curve and flow duration curve, Concept of unit hydrograph, Methods of estimation of unit hydrograph, Ground water hydrology, Types of aquifers and wells, Darcy's law and its limitations.

Geotechnical Engineering: Soil structure and mineralogy, Phase diagrams, Index properties and classification of soils, Stresses within soil, Permeability of soils, Compaction, Consolidation, Shear strength, Seepage pressure, Earth pressure theories, Shallow and deep foundations.

Environmental Engineering: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, basic unit operations and unit processes for surface water treatment, Sewage and sewerage treatment, quantity and characteristics of wastewater, Primary, secondary and tertiary treatment of wastewater, effluent discharge standards, sludge disposal, Solid and hazardous waste management.

Transportation Engineering: Highway planning and geometric design, Highway material, Properties of sub-grade and pavement component material, Highway construction – WBM, bituminous and cement concrete pavement, Design of pavement and its factors for flexible and rigid pavements.

DEPARTMENT OF MANAGEMENT

GENERAL MANAGEMENT; Concept of Management, Evolution of Management, Functions of Management

ORGANISATIONAL BEHAVIOUR; Concepts and Significance of OB, Understanding and Managing Behaviour- Personality, Perception, Values, Attitudes, Learning and Motivation, Leadership, Managing Conflicts, Organisational Development.

HUMAN RESOURCES MANAGEMENT; Concepts and perspective in HRM, Human Resource Planning-Objectives , process and Techniques, Recruitment and Selection, Performance appraisal system and evaluation, Methods of training and development programs, Dispute Resolution and Grievance Management, Labour Welfare and Social Security measures.

FINANCIAL MANAGEMENT; Nature and Scope, Long term and Short term Financing Instruments, Working Capital Management, International Financial Management

MARKETING MANAGEMENT; Concepts , Nature and Scope, Marketing Mix –Product, Price, Place and Promotion, Role and Relevance of segmentation Targeting and Positioning, Product Life Cycle, Branding and Packaging, Marketing of Services

DEPARTMENT OF PHYSICS

Mathematical Methods of Physics: Eigen values and eigenvectors, linear ordinary differential equations, Special functions. Fourier series, Transforms, Elements of complex analysis, Elementary probability theory, random variables, Distributions, Green's function, Partial differential equations, Elements of computational techniques, Tensors.

Classical Mechanics: Newton's laws, Central force motions, two body Collisions - scattering in lab and C.m. frames , Rigid body dynamics, Non-inertial frames and pseudo forces, Lagrangian and Hamiltonian formalism, small oscillations, normal modes, Special theory of relativity, Lorentz transformations, relativistic kinematics.

Electromagnetic Theory: Laplace and Poisson equations, boundary value problems, Maxwell's equations in free space and linear isotropic media, Scalar/ vector potentials, gauge invariance, Dispersion relations in plasma, Lorentz invariance of Maxwell's equations, Transmission lines and wave guides, Radiation- from moving charges and dipoles, Retarded potentials.

Quantum Mechanics: Schrödinger's equation and its Applications for simple problems, Heisenberg uncertainty principle, Dirac notation , Motion in a central potential, angular momentum algebra, Hydrogen atom, Approximation methods, Fermi's golden rule, Pauli exclusion principle, Elementary theory of scattering, Klein-Gordon and Dirac equations.

Thermodynamic and Statistical Physics: Laws of thermodynamics, Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria, micro- and macro-states, Micro-canonical, canonical and grand-canonical ensembles and partition functions, Free energy and its connection with thermodynamic quantities, Classical / quantum statistics, Bose and Fermi gases, Diamagnetism, Para magnetism, and ferromagnetism, Bose-Einstein condensation, Diffusion equation, , No equilibrium processes.

Electronics and Experimental Methods: Semiconductor devices, frequency dependence and application, Opto-electronic devices, Operational amplifiers and their applications, Digital techniques and applications, Microprocessor and microcontroller basics.

Atomic & Molecular Physics: Spectrum of He and alkali atoms, LS & JJ couplings, Zeeman, Paschen-Bach & Stark effects, E.S.R. and N.M.R., chemical shift, Frank-Condon principle, Born-Oppenheimer approximation, Diatomic molecules, spectra, Lasers.

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, Hall effect , Periodic potential, Type-I and type-II superconductors, Josephson junctions, Super fluidity, Defects and dislocations. **Nuclear and Particle Physics:** 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, Shell structure, single-particle shell model, Rotational spectra, Fission and fusion, Classification of fundamental forces, Quark model, C, P, and T invariance, Weak interactions.

DEPARTMENT OF CHEMISTRY

Organic Chemistry Carbonium ions, carbanions, carbenes, nitrenes, radicals and arynes, Reactive intermediates, Nucleophilic, Electrophilic, Radical substitution, Addition and Elimination reactions. Barton, Baeyer-villiger, Birch, Chichibabin, Clemmensen Diels-alder, Friedel crafts, Hoffmann, Hofmann-Löffler-Freytag, Hydroboration, Lossen, Mannich, Michael addition, Meerwein-Ponndorf-Verley, Perkin, Grignard, Reimer-Tiemann, Reformatsky, Storkenamine, Wittig, Wolff-Kishner. Oppenauer oxidations, Robinson annulations, Routine functional group transformations and inter-conversions of simple functionalities, Aldol, Claisen, Stobbe and Dieckmann, Schmidt, Condensations, Beckmann and Fries, Favorski, Curtius Rearrangements. Stereochemistry and Conformational Analysis: Pericyclic Reactions, **Photochemistry, Dyes. Physical Chemistry:** Basic principles and applications of quantum mechanics, Variational and perturbational methods. Basics of atomic structure, electronic configuration, shape of orbitals, hydrogen atom spectra. Theoretical treatment of atomic structures and chemical bonding. Chemical applications of group theory. Basic principles and application of spectroscopy – rotational, vibrational, electronic, Raman, ESR, NMR.

Chemical thermodynamics. Phase equilibria. Statistical thermodynamics. Chemical equilibria. Electrochemistry, Chemical kinetics, Polymer chemistry, Solid State Chemistry, Collisions and surface phenomena, Non-ideal systems,

Inorganic Chemistry Chemical periodicity. Structure and bonding, Concepts of acids and bases, Chemistry of the main group elements and their compounds. Allotropy, synthesis, bonding and structure, Chemistry of transition elements and coordination compounds, Inner transition elements, Organometallic compounds, Cages and metal clusters, Analytical chemistry separation techniques. Spectroscopic electro- and thermoanalytical methods, Bioinorganic chemistry, Physical characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-, NQR, MS, electron spectroscopy and microscopic techniques. Nuclear chemistry.

DEPARTMENT OF MATHEMATICS

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.

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,

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,

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, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Special Functions & Integral Transform: Gauss hypergeometric function and its properties, Integral representation, Linear and quadratic transformation formulas, Contiguous function relations, Integral representation, Legendre functions $P_n(x)$ and $Q_n(x)$ and their properties. Bessel functions $J_n(x)$. Laplace transform, Fourier Transforms,

Fluid Dynamics: Governing equations of fluid motion; stream line; velocity potential, path line, equation of continuity, Motion in two dimensions; stream function; complex potential; source; sink and doublet; image circle theorem, Viscous fluid, Stokes-Navier equations;

Discrete Mathematics: Set Theory, Types of relations on sets and their properties, Relational matrix and the graph of a relation, Partitions, Equivalence relations, Poset, Hasse diagram. Definitions & Classification of functions, Characteristic function of a set, Hashing functions, Recursive functions, Permutation functions. Discrete numeric function, Basic counting principles, Generating functions, Recurrence relations, Inclusion and exclusion principle,

Linear Programming Problem: The Linear programming problem. Mathematical Formulation of the Problem, Types of solutions, Linear programming in matrix notation. Some Exceptional Cases,

General Linear Programming Problem Slack and Surplus Variables, Theory and application of the simplex method of solution of a linear programming problem, Charne's M-technique, The two phase method, Duality, Transportation & Assignment Problems.

DEPARTMENT OF ENGLISH

AGE OF CHAUCER TO THE NEO CLASSICAL AGE: Geoffrey Chaucer: 'The Prologue to The Canterbury Tale's'; William Langland: Piers Plowman; Edmund Spenser: The Faerie Queen (Book I); Christopher Marlowe: Dr. Faustus; Ben Jonson: The Alchemist; John Donne: 'The Flea', 'The Canonization'; Andrew Marvell: 'To His Coy Mistress'; Francis Bacon: Essays 'Of Truth', 'Of Studies'; William Shakespeare: A Midsummer Night's Dream, Hamlet, Macbeth, Sonnet No. 18, 116; John Webster: The Duchess of Malfi; John Milton: Paradise Lost (Book I); John Dryden: MacFlecknoe; Thomas Gray: 'Elegy Written in a Country Churchyard'; William Collins: 'To Evening'; William Congreve: The Way of the World; Daniel Defoe: Robinson Crusoe; Richard Sheridan: The Rivals; Joseph Addison: 'The Spectator's Account of Himself'; Richard Steele: 'Of the Club'; Alexander Pope: The Rape of the Lock

AGE OF ROMANTICISM TO THE MODERN AGE: William Wordsworth: 'The Prelude'; Samuel Taylor Coleridge: 'The Rime of the Ancient Mariner'; Lord Byron: Childe Harold's Pilgrimage (Cantos 1 & 2); Percy Bysshe Shelley: 'Ode to the West Wind'; John Keats: 'Ode on a Grecian Urn', 'Ode to Autumn', 'Ode to a Nightingale'; Alfred Lord Tennyson: 'Ulysses'; Robert Browning: 'The Last Ride Together', 'Porphyria's Lover'; Mathew Arnold: 'Dover Beach'; Gerard Manley Hopkins: 'The Windhover'; William Hazlitt: 'On Going a Journey'; Charles Lamb: 'Dream Children: A Reverie'; Jane Austen: Pride and Prejudice; George Eliot: Middlemarch; Charles Dickens: David Copperfield; Thomas Hardy: Far From the Madding Crowd; Thomas Stearns Eliot: 'The Waste Land'; Wystan Hugh Auden: 'The Unknown Citizen'; William Butler Yeats: 'Sailing to Byzantium'; Virginia Woolf: To the Lighthouse; George Bernard Shaw: Man and Superman; David Herbert Lawrence: Sons and Lovers; Joseph Conrad: Heart of Darkness; James Joyce: A Portrait of the Artist as a Young Man; Philip Larkin: 'Churchgoing'; Ted Hughes: 'Hawk Roosting'; Harold Pinter: The Birthday Party; Arnold Wesker: Chicken Soup with Barley; Tom Stoppard: Rosencrantz and Guildenstern are Dead; Kingsley Amis: Lucky Jim; John Fowles: The French Lieutenant's Woman

INDIAN AND OTHER LITERATURES IN ENGLISH: Toru Dutt: 'Our Casuarina Tree'; Nissim Ezekiel: 'Night of the Scorpion'; Raja Rao: Kanthapura; Girish Karnad: Tughlaq; Mahesh Dattani: Tara; Shashi Deshpande: That Long Silence; Salman Rushdie: Midnight's Children; Arundhati Roy: The God of Small Things; Amitav Ghosh: The Hungry Tide; Walt Whitman: 'A Passage to India'; Emily Dickinson: 'I Heard a Fly buzz – when I Died'; Robert Frost: 'Mending Walls', 'Stopping by the Woods'; Arthur Miller: Death of a Salesman; Ernest Hemingway: Old Man and the Sea; Toni Morrison: The Bluest Eye; Margaret Atwood: Surfacing; Khaled Hosseini: The Kite Runner; Chinua Achebe: Things Fall Apart

LITERARY CRITICISM AND THEORY: Aristotle: Poetics (Translated by Butcher); Philip Sidney: 'An Apologie for Poesie'; John Dryden: 'Essay of Dramatic Poesie'; Samuel Johnson: 'Preface to Shakespeare'; Mary Wollstonecraft: Vindication of the Rights of Woman; William Wordsworth: 'Preface to the Lyrical Ballads' (1800 Edition); Thomas Stearns Eliot: 'Tradition and Individual Talent'; Ivor Armstrong Richards: 'The Four

Kinds of Meaning'; Cleanth Brooks: 'The Language of Paradox'; Ferdinand de Saussure: 'Course in General Linguistics'; Jacques Derrida: 'Structure, Sign and Play in the Discourse of Human Sciences'

LITERARY DEVICES: Literary Terms; Figures of Speech; Literary Forms, Literary Genres; Literary Movements

Physiotherapy

- Applied Anatomy — musculoskeletal, neurological and cardiopulmonary systems
- Applied Physiology relevant to human movement and rehabilitation
- Biomechanics and Kinesiology — normal and pathological movement patterns
- Musculoskeletal / Orthopedic Physiotherapy
- Assessment and physiotherapy management of common orthopedic conditions
- Pre- and post-operative rehabilitation protocols
- Manual therapy concepts and mobilization techniques
- Neurological Physiotherapy
- Stroke, traumatic brain injury and spinal cord injury rehabilitation
- Parkinson's disease, multiple sclerosis and other neurodegenerative conditions
- Motor control, motor learning and neuroplasticity principles
- Cardiopulmonary & Critical Care Physiotherapy
- Cardiopulmonary assessment and rehabilitation protocols
- Physiotherapy in ICU and critical care settings
- Chronic respiratory disease management
- Electrotherapy, Actinotherapy & Biophysical Agents
- Principles and physiological effects of electrotherapeutic modalities
- Therapeutic applications of light, heat and cold agents
- Evidence for use of biophysical agents in clinical practice
- Exercise Therapy & Rehabilitation Techniques
- Principles of therapeutic exercise prescription
- Strength, flexibility, balance and functional training approaches
- Emerging rehabilitation technologies (robotics, virtual reality, telerehabilitation)
- Community, Pediatric & Geriatric Physiotherapy
- Community-based rehabilitation (CBR) models
- Developmental assessment and pediatric physiotherapy conditions
- Age-related changes and geriatric rehabilitation approaches
- Sports physiotherapy — injury prevention and return-to-sport protocols
- Current Trends & Advances
- Recent advances and emerging areas of research in physiotherapy
- Interdisciplinary and translational research directions
- Alignment with the department's ongoing research focus areas