Dayananda Sagar University

Faculty of Engineering & Technology

A) Department of Computer Science & Engineering

Syllabus for Ph. D Entrance Test- 2025
Computer Science & Engineering/Information Science & Engineering/Information Technology/Computer Sciences/Computer Applications

PART B

I) Mathematics

Section1: Discrete Mathematics: Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions.

Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and eigenvectors, LU decomposition.

Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration.

Numerical Analysis –Numerical Solutions of Algebraic and transcendental equations, Finite differences, Interpolation (For equal and unequal intervals) Numerical solutions of first order differential equations, Numerical Integration

Probability& Statistics: Random variables. Uniform, normal, exponential, Poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.

Dayananda Sagar University

II) Computer Science & Engg., Information Science & Engg, Information Technology, Computer Science, and MCA

Section 2: Digital Logic Boolean algebra. Combinational and sequential circuits. Minimization. Number representations and computer arithmetic (fixed and floating point).

Section 3: Computer Organization and Architecture Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).

Section 4: Programming and Data Structures Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search tree, binary heaps, graphs. Algorithms: Searching, sorting, hashing. Asymptotic worst-case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, and shortest paths.

Section 5: Machine Learning: Types of Learning, Bias-Variance Trade-off, Overfitting, Underfitting, Evaluation Metrics, Supervised Learning: Regression and Classification Problems – Linear Regression, Logistic Regression, K-Nearest Neighbors, Naïve Bayes Classifier, Support Vector Machine, Decision Trees, Random Forests, Cross-validation Techniques, Unsupervised Learning: K-Means Clustering, Hierarchical Clustering, Dimensionality Reduction - Principal Component Analysis (PCA).

Section 6: Theory of Computation Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.

Section 7: Compiler Design Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.

Section 8: Operating System Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Section 9: Databases ER-model. Relational model: relational algebra, tuple calculus, SQL. Integrity constraints, normal forms. File organization, indexing (e.g., B and B+ trees). Transactions and concurrency control.

Section 10: Computer Networks Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Dayananda Sagar University

B) Department of Mechanical Engineering
Syllabus for Ph. D Entrance Test- 2025

in

Mechanical Engineering and Allied areas

PART B

Broad Areas of Research

Machine Design, Vibrations, CAD, Finite Element Methods, Composite Materials, Mechatronics, Robotics, System Dynamics & Control, Modeling & Simulation of Physical System, Bio Mechanics, Heat Transfer, CFD, IC Engines, Combustion Diagnostics, Alternative Bio-fuels, Thermal System Design, Alternative Refrigerants, Heat Exchanger Design, Power Plant Engineering, Turbo Machinery, Fluid Mechanics, Welding Renewable Energy, Bulk Material Handling.

Note: The students appearing in the PhD entrance test are expected to prepare the various topics which have been listed below:

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, including impulse and momentum (linear and angular) and energy formulations; impact.

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; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

Theory of Machines:

Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels.

Vibrations:

Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

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, spur gears, rolling and sliding contact bearings, brakes and clutches.

Fluid Mechanics and Thermal Sciences

Fluid Mechanics:

Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

Heat-Transfer:

Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

Thermodynamics:

Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. Irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

Applications:

Power Engineering: Steam Tables, Rankine, Brayton cycles with regeneration and reheat. *I.C. Engines*: air-standard Otto, Diesel cycles. *Refrigeration and air-conditioning*: Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes. *Turbomachinery:* Pelton wheel, Francis and Kaplan turbines - impulse and reaction principles, velocity diagrams. Manufacturing and Industrial Engineering

Engineering Materials

Structure and properties of engineering materials, heat treatment, stress-strain diagrams for engineering materials.

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 (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) 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, tool life and wear; economics of machining; principles of non-traditional machining processes; principles of work holding, principles of 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:

Deterministic and probabilistic models; safety stock inventory control systems.

Operations Research:

Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queuing models, PERT and CPM.

Dayananda Sagar University

A) Department of Electronics & Communication Engineering

Syllabus for Ph. D Entrance Test- 2025

in

Electronics & Communication Engineering and Allied Areas

PART B

Section 1: Networks

Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Solution methods: nodal and mesh analysis. Network theorems: superposition, Thevenin and Norton's maximum power transfer, Wye-Delta transformation. Steady state sinusoidal analysis using phasors. Linear constant coefficient differential equations; time domain analysis of simple RLC circuits, Solution of network equations using Laplace transform: frequency domain analysis of RLC circuits.2-port network parameters: driving point and transfer functions. State equations for networks.

Section 2: Electronic Devices

Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. P-n junction diode, Zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, p-I-n and avalanche photo diode, Basics of LASERs. Device technology: integrated circuits fabrication process, oxidation, diffusion, ion implantation, photolithography, n-tub, p-tub and twin-tub CMOS process.

Section 3: Analog Circuits

Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers: single- and multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers.

Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op- amp configurations. Function generators and wave-shaping circuits, 555 Timers. Power supplies.

Section 4: Digital circuits

Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs. Sequential circuits: latches and flip-flops, counters and shift-registers.

Sample and hold circuits, ADCs, DACs. Semiconductor memories. Microprocessor (8085): architecture, programming, memory and I/O interfacing.

Section 5: Signals and Systems

Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, DFT and FFT, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

Section 6: Control Systems

Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response. Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots. Control system compensators: elements of lead and lag compensation, elements of Proportional-Integral-Derivative (PID) control. State variable representation and solution of state equation of LTI control systems.

Section 7: Communications

Random signals and noise: probability, random variables, probability density function, autocorrelation, power spectral density. Analog communication systems: amplitude and angle modulation and demodulation systems, spectral analysis of these operations, super heterodyne receivers; elements of hardware, realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of

information theory and channel capacity theorem. Digital communication systems: pulse code modulation (PCM), differential pulse code modulation (DPCM), digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Section 8: Electromagnetics

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: Dipole antennas; radiation pattern; antenna gain.

Dayananda Sagar University

D)Department of Aerospace Engineering

Syllabus for Ph. D Entrance Test- 2025

In

Aerospace Engineering and Allied areas

Broad Areas of Research

Department of Aerospace Engineering can offer the Ph. D courses on the following topics.

1. Aerodynamics
2. Aerospace Propulsion
3. Computational methods in aerospace applications
4. Satellite Engineering
5. Advanced materials and structures
6. Turbine blade cooling and Thermal barrier coatings

Note: The students appearing in the PhD entrance test are expected to prepare the various topics which have been listed below:

PART B

Section 1: Mathematics:

Matrices, determinants, system of linear equations, eigen values and eigen vectors, LU decomposition, Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration, numerical Solutions of Algebraic and transcendental equations, Finite differences, Interpolation (For equal and unequal intervals) Numerical solutions of first order differential equations, Numerical Integration, Probability& Statistics

Section 2: Fluid Mechanics:

Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow

through pipes, head losses in pipes, bends etc.

Section 3: Thermodynamics:

Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle. Irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

Section 4: Aerospace Materials:

Aerospace materials and their requirements, Structure and properties of engineering materials, Strength, durability and testing of aerospace materials, Light metal alloys, Composite materials, Steels & Superalloys, Heat treatment

Section 5: Aerodynamics:

Laminar and Turbulent, Incompressible and Compressible Flows, Subsonic, Transonic and Supersonic flows, flow past wing surfaces and bluff bodies, Wind tunnels, Aerodynamic test techniques and instruments, Flow-induced vibrations, Flow through air-intakes at subsonic to supersonic Mach numbers, Aeroelasticity, Flow control using passive and active control devices, aerodynamic drag reduction techniques

Section 6. 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; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses.

Section 7: Theory of Machines and Vibration:

Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; gear trains; flywheels. Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Section 8: Product 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, spur gears, rolling and sliding contact bearings, brakes and clutches.

Section 9: Aircraft Propulsion and Jet Engines:

Classification of aircraft engines, Performance Parameters, Euler's work, various efficiencies, spooling, cycle calculations, fans and compressors, combustors, turbines, intake and exhaust systems, after burners, CD nozzles, Aircraft fuels, blade cooling

Section 10: Avionic systems and Control systems:

Analog communication systems, Digital communication systems, International standards for avionics equipment, Navigation systems, Basic control system components, Open loop and closed loop (feedback) systems and stability analysis of these systems, Control system compensators, elements of Proportional-Integral-Derivative (PID) control, flight control systems, Collision-avoidance systems.

Section 11: Aircraft Systems:

Fuel system, lubrication system, pressurization system, air condition system, thrust reversal system, braking system, power system, propulsion system, landing gear system, ventilation system

Section 12: Space Environment and Orbital Mechanics:

Perfect Vacuum, Magnetic and Radiation fields, dynamics of point masses, Orbital position, Orbit determination, Interplanetary trajectories

Section 13: Computational Methods:

Finite difference method, finite volume method, finite element method, convergence, numerical errors, numerical stability and grid generation methods