Ph. D. Entrance Exam Syllabus

Automobile Engineering


Civil Engineering

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.


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.

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**Chemical Engineering**

1: **Engineering Mathematics**

**Linear Algebra:** Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

**Differential equations:** First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Cauchy’s and Euler’s equations, Initial and boundary value problems, Laplace transforms, Solutions of one dimensional heat and wave equations and Laplace equation.

**Statistics:** Mean, median, mode and standard deviation, Random variables, Poisson, Normal and Binomial distributions, Linear regression analysis.

**Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations. Integration by trapezoidal and Simpson’s rule. Single and multi-step methods for numerical solution of differential equations

2: **Process Calculations and Thermodynamics**

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb’s phase rule and degree of freedom analysis. First and Second laws of thermodynamics.
Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

3: Fluid Mechanics
Fluid statics, Newtonian and non-Newtonian fluids, shell-balances including differential form of Bernoulli equation and energy balance, Macroscopic friction factors, flow through pipeline systems, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds.

4: Heat Transfer
Steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations. Design of double pipe, shell and tube heat exchangers, single and multiple effect evaporators.

5: Mass Transfer
Fick’s laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

6: Chemical Reaction Engineering
Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors; residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.
Computer Science and Information Technology (CSE)

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 & Electronics Engineering (EEE)**


3. 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.

4. 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.

5. 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.

6. 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.


**Mechanical Engineering Manufacturing**


**Mechatronics Engineering**

DESIGN OF ROBOTIC COMPONENTS: Motion control analysis of actuators, Control parameters and system objectives, Motion control algorithms, Architecture of intelligent machines, Homogenous transformations, INTELLIGENT CONTROLLERS: Single layer feed forward networks, multilayer feed forward networks, single layer feedback networks, multilayer feedback networks, Fuzzy control, STABILITY ANALYSIS OF CONTROL SYSTEMS; time domain specifications for second order systems, Steady state errors, Frequency domain analysis, Stability analysis, Routh Hurwitz criterion, Root locus plots, Nyquist criterion, NUMERICAL ANALYSIS; Mathematical modeling of Engineering problems, Roots of equations, Linear Algebraic Equations, Numerical differentiation and Integration, Numerical solutions to differential equations.