Engineering Mathematics

- **Calculus:** -Theorems of integral calculus,Mean Value Theorem, Evaluation of definite and improper integrals, Maxima and minima,Partial Derivatives, Multiple integrals, Fourier series. Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems,Vector Identities
- **Differential equations:** -First order equation (linear and nonlinear), Cauchy's and Euler's equations, Method of Variation of parameters,Initial and boundary value problems, Partial Differential Equations and variable separable method, Higher order linear differential equations with constant coefficients
- **Complex variables:** Analytic functions,Taylor's and Laurent' series, Residue theorem, solution integrals, Cauchy's integral theorem and integral formula.
- **Probability and Statistics:** -Sampling theorems, Mean, median, Conditional probability, mode and standard deviation, Random variables, Discrete and continuous distributions, Correlation and regression analysis,Poisson, Normal and Binomial distribution
- **Numerical Methods:** -Single and multi-step methods for differential equations,Solutions of non-linear algebraic equations
- **Transform Theory: It is the Study of transforms.** -Fourier transform, Z-transform, Laplace transform

Electronics and Communication Engineering-

- **Networks:** -Network graphs: matrices associated with graphs; incidence, fundamental cut set and fundamental circuit matrices. Network theorems:superposition, Wye-Delta transformation. 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. Thevenin and Norton's maximum power transfer, Steady state sinusoidal analysis using phasors, Solution methods: nodal and mesh analysis
- **Electronic Devices:** - Carrier transport in silicon: diffusion current, mobility, and resistivity, drift current. Generation and recombination of carriers. p-n junction diode, , MOSFET, LED, p-I-n and avalanche photo diode, LASERs basics. Device technology includes integrated circuits fabrication process, diffusion ,oxidation, ion implantation, photolithography, p-tub,n-tub and twin-tub CMOS process,

Energy bands in silicon, intrinsic and extrinsic silicon, Zener diode, tunnel diode, JFET, BJT, MOS capacitor

- **Analog Circuits:** -Small Signal Equivalent circuits of diodes, MOSFETs and analog CMOS , BJTs. Simple diode circuits, clamping, clipping, rectifier. Biasing and bias stability of transistor and FET amplifiers. Amplifiers includes single-and multi-stage,operational and differential, feedback, and power.. Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations ,Frequency response of amplifiers, Function generators and 555 Timers,wave shaping circuits. Power supplies.
- **Digital circuits:** - Minimization of Boolean functions; Boolean algebra ,logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinatorial circuits includes arithmetic circuits, multiplexers,code convertors, decoders, PLAs and PROMs. Sequential circuits includes counters and shift-registers, latches and flip-flops,. Sample and hold circuits, DACs, ADCs. Semiconductor memories. Microprocessor(8085): architecture, memory and I/O interfacing, programming.
- **Signals and Systems:** -Definitions and properties of Laplace transform, continuous-time and discrete-time Fourier series, DFT and FFT, discrete-time and continous-time Fourier Transform, z-transform. Sampling theorem. Linear Time-Invariant (LTI) Systems includes definitions and properties; causality, impulse response, stability ,convolution, poles and zeros, frequency response, cascade and parallel structure, phase delay,group delay. Signal transmission through the LTI systems.
- **Control Systems:** - Basic control system components; reduction of block diagrams , block diagrammatic description. Open loop and closed loop (feedback) systems and stability analysis of these systems;steady state and transient analysis of LTI control systems and frequency response ,Signal flow graphs and their use in determining transfer functions of systems. Tools and techniques for LTI control system analysis: Routh-Hurwitz criterion, root loci,Nyquist and Bode plots. Control system compensators:elements of Proportional-Integral-Derivative (PID) control ,elements of lead and lag compensation. State variable representation & solution of state equation of LTI control systems.
- **Communication:** - Random signals and noise: probability, probability density function, random variables , power spectral density, random variables. Analog communication systemsincludes spectral analysis of the following operations, amplitude and angle modulation and demodulation systems, superheterodyne 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. Digital communication system includes pulse code modulation (PCM), differential pulse code modulation

(DPCM), digital modulation schemes includes amplitude, phase and frequency shift keying schemes (ASK, FSK, PSK), matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of FDMA, TDMA and GSM and CDMA. Fundamentals of information theory and channel capacity theorem

- **Electromagnetics:** -Elements of vector calculus includes divergence and curl; Maxwell's equations: differential and integral forms, Gauss' and Stokes' theorems. Poynting vector ,Wave equation. Plane waves includes propagation through various media; reflection and refraction; skin depth phase and group velocity . Transmission lines: characteristic impedance; Smith chart; impedance matching, impedance transformation; S parameters, pulse excitation. Waveguides includes: modes in rectangular waveguides; cut-off frequencies; boundary conditions, dispersion relations. Basics of propagation in optical fibers and dielectric waveguide. Basics of Antennas includes: radiation pattern; Dipole antennas, antenna gain.

Syllabus of Mechanical Engineering For Ph.D Entrance examination

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.