SyllabuS for Ph.D. aDmiSSion TeST 2021-22

Department of Mechanical Engineering :-

Syllabus for written test for Master'sDegree holders without GATE qualification applying in Mechanical Engineering Department for PhD

Part 1: Research Methodology (50 marks)

Mathematics:

Linear Algebra:Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.

Calculus: Function of single variable, limit, continuity and differentiability, mean value theorems, intermediate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables) maxima and minima, Fourier Series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stocks and Green's theorems.

Differential equations: First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula, Taylor and Laurent series.

Definitions of probability, sampling theorems, conditional probability, mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Numerical solutions of linear and nonlinear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations, interpolation and curve-fitting

Experimental Methods and Measurements:

Theoretical, Computational and Experimental Research Methodologies. Objectives of Experiments: Monitoring, Control and Research.System and Variable Identifications, Planning of Instrumentation, Design Of Experiments. Analog and Digital Measurements, Static and Dynamic Measurements. Accuracy, Precision,Sources of Errors in Measurements, and Uncertainty Analysis. Performance Characteristics, Order of Instruments and Calibration.

Part 2: Mechanical Engineering(50 marks)

Section 1: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 acceleration analysis of plane mechanisms dynamic analysis of linkages camps gears and gear trains flywheels and governors balancing of reciprocating and rotating masses glidescope vibrations

free and forced vibration of single degree of freedom systems effect of damping vibration isolation is an in critical speed of shapes

Machine design: design for Static and dynamic loading failure theories fatigue strength and the SN diagram principles of the design and missing elements such as v a riveted and welded joints spec years rolling and sliding contact bearing brakes and clutches springs.

Section 2: 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.

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 correlation for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stafan Boltzmann law, Wien's displacement law, black and grey surfaces, view factors, radiation network analysis.

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

Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan top turbines.

Section 3 : Materials, Manufacturing and Industrial Engineering:

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

Casting Forming and Joining Processes: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and getting design. Plastic deformation and yield criteria; fundamentals of hot and cold working process; 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 testing methods; tolerance analysis in manufacturing assembly.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools. Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials and requirement planning.

Inventory Control: Deterministic models; safety stock inventory control systems.

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