Ph.D. Entrance Exam

Subject: Mechanical Engineering

Syllabus

UNIT-I : ENGINEERING MATERIALS THEIR TESTING AND PRODUCTION TECHNOLOGY

Engineering Materials their Testing : Structure and Properties of engineering materials ,heat treatment,Material testing-Tensile test,Hardness test,Fatigue test,Iron-Carbon equilibrium diagram

Metal Casting:

Casting processes- types and applications; patterns- types and materials; allowances; moulds and cores- materials, making, and testing; casting techniques of cast iron, steels and nonferrous metals and alloys; solidification; design of casting, gating and risering; casting inspection, defects and remedies.

Metal Joining Processes:

Welding processes- manual metal arc, MIG, TIG, plasma arc, submerged arc, electroslag, thermit, resistance, forge, friction, and explosive welding; other joining processes- soldering, brazing, braze welding; inspection of welded joints, defects and remedies; introduction to advanced welding processes-ultrasonic, electron beam, laser beam; thermal cutting.

Machining and Machine Tool Operations:

Basic machine tools; machining processes-turning, drilling, boring, milling, shaping, planning, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics of machining- geometry of cutting tools, chip formation, cutting forces and power requirements, Merchant's analysis; selection of machining parameters; tool materials, tool wear and tool life, economics of machining, thermal aspects of machining, cutting fluids, machinability ; principles and applications of non traditional machining

processes-USM, AJM, WJM, EDM and Wire cut EDM, LBM, EBM, PAM,CHM, ECM.

UNIT-II :BASIC CONCEPT OF FLUIDS AND FLUID MACHINES

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.

UNIT-III :THERMODYNAMICS

Zeroth, First and Second laws of thermodynamics and applications of first law of Thermodynamics to Non-flow or Closed; thermodynamic system and processes; Carnot cycle, irreversibility and availability; behavior 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; Boiler mounting and Accessories; performance of boilers; Refrigeration Cycles; Coefficient of performance; Simple vapour compression system; Vapour Absorption System.

UNIT-IV: DESIGN ,MECHANICS AND VIBRATIONS

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.

Engineering Mechanics:

Free body diagrams and equilibrium; Lami's theorem; 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 formulation 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 Machine:

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.

UNIT-V: Industrial Engineering

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.

Operation Research: Linear programming,simplex and duplex method,transportation,assignment ,network flow models,simple Queing models,PERT and CPM.

Production Planning and Control: Forecasting models, aggeregating production planning Scheduling, materials requirement planning. Inventory Control,Material handling equipment and supply chain management,Ergonomics ;Time and motion studies.

Suggested Readings :

1. R.K.Rajput " Thermal Engineering" , Laxmi Publication Ltd. New Delhi.
2. Arora C.P., "Refrigeration and air conditioning", TMH New Delhi.
3. J.P. Holman "Heat Transfer" Mc Graw Hill VII Edition Publication.
4. C.M. Sadiwala, " Materials and Financial Management", New Age Publication. New Delhi.
5. G. K. Grover " Mechanical Vibration" New Chand & Bros Roorkee.
6. Dr. R.K. Bansal, "Fluid Mechanics & Hydrolic M/c" , Laxmi Publication Ltd. New Delhi.
7. R.S. Khurm; "Applied Mechanics" S. Chand Publication.

8. R.S. Khurm; "Design of Machine Elements", S. Chand Publication.

9. Norton, "Dynamics of Machinery" Tata Mc- Graw Hills.

10. Thomas & Beven, "Theory of Machine" Tata Mc- Graw Hills.

11. V.Ganeshan, "Internal Combustion Engine" 2/e Tata Graw Hills, New Delhi.

12. S.D. Sharma " Opretion Research" Khanna Publication.

13. R.K. Jain " Production Technology"

14. R.K. Rajput "Mechanical Engineering" Firewell Media.