

Syllabus

Subject : Mechanical Engineering

Theory of Machines

Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope.

Machine 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, gears, rolling and sliding contact bearings, brakes and clutches, springs.

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

Strength 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; testing of materials with universal testing machine; testing of hardness and impact strength.

Thermodynamics

Properties of Pure Substances : p-v & P-T diagrams of pure substance like H₂O, Introduction of steam table with respect to steam generation process; definition of saturation, wet & superheated status. Definition of dryness fraction of steam, degree of superheat of steam. h-s chart of steam (Mollier's Chart).

1st Law of Thermodynamics : Definition of stored energy & internal energy, 1st Law of Thermodynamics for cyclic process, Non Flow Energy Equation, Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady Flow; Steady State Steady Flow Energy Equation.

2nd Law of Thermodynamics : Definition of Sink, Source Reservoir of Heat, Heat Engine, Heat Pump & Refrigerator; Thermal Efficiency of Heat Engines & co-efficient of performance of Refrigerators, Kelvin – Planck & Clausius Statements of 2nd Law of Thermodynamics, Absolute or Thermodynamic Scale of temperature, Clausius Integral, Entropy, Entropy change calculation for ideal gas processes. Carnot Cycle & Carnot Efficiency, PMM-2; definition & its impossibility.

Air standard Cycles for IC engines : Otto cycle; plot on P-V, T-S Planes; Thermal Efficiency, Diesel Cycle; Plot on P-V, T-S planes; Thermal efficiency.

IC Engine Performance, IC Engine Combustion, IC Engine Cooling & Lubrication.

Rankine cycle of steam : Simple Rankine cycle plot on P-V, T-S, h-s planes, Rankine cycle efficiency with & without pump work.

Boilers; Classification; Specification; Fittings & Accessories : Fire Tube & Water Tube Boilers.

Air Compressors & their cycles; Refrigeration cycles; Principle of a Refrigeration Plant; Nozzles & Steam Turbines

Fluid Mechanics & Machinery

Properties & Classification of Fluids: ideal & real fluids, Newton's law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids.

Fluid Statics: Pressure at a point.

Measurement of Fluid Pressure: Manometers, U-tube, Inclined tube.

Fluid Kinematics: Stream line, laminar & turbulent flow, external & internal flow, continuity equation.

Dynamics of ideal fluids: Bernoulli's equation, Total head; Velocity head; Pressure head; Application of Bernoulli's equation.

Measurement of Flow rate Basic Principles: Venturimeter, Pilot tube, Orifice meter.

Hydraulic Turbines: Classifications, Principles.

Centrifugal Pumps: Classifications, Principles, Performance.

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, thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat

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

Production Engineering

Classification of Steels: mild steel & alloy steel, Heat treatment of steel, welding – Arc Welding, Gas Welding, Resistance Welding, Special Welding Techniques i.e. TIG, MIG, etc. (Brazing & Soldering), Welding Defects & Testing; NDT, Foundry & Casting – methods, defects, different casting processes, Forging, Extrusion, etc, Metal cutting principles, cutting tools, Basic Principles of machining with (i) Lathe (ii) Milling (iii) Drilling (iv) Shaping (v) Grinding, Machines, tools & manufacturing processes.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials 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.