

ME – MECHANICAL ENGINEERING

MATHEMATICAL FUNDAMENTALS

Engineering Mathematics

Geometry Equations of straight line, common normal between straight lines in space; Equations of circles, ellipse, etc.; Parametric representation.

Linear Algebra

Matrix algebra, Systems of linear equations, Eigen values and eigenvectors.

Calculus

Functions of single variable, Limit, continuity and differentiability, Mean value theorems, Evaluation of definite and improper integrals, Partial derivatives, Total derivative, Maxima and minima, Gradient, Divergence and Curl, Vector identities, Directional derivatives,

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.

Control Theory

Open and closed loop systems; Laplace transforms; Transfer function; Block Diagram analysis; Concepts of stability; Input signals and system response; Nyquist stability criterion; Bode plot.

Probability and Statistics

Definitions of probability and sampling theorems, Conditional probability, Mean, median, mode and standard deviation, Permutations and combinations, Random variables, Poisson, Normal and Binomial distributions. Properties of normal curve; Statistical quality control

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, 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; thermal stresses; Stress concentration factor; Fatigue Strength and S-N curve; failure theories.

Theory of Machines

Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of slider-crank mechanism; flywheels.

Vibrations

Free and forced vibration of single degree of freedom systems; effect of damping; vibration isolation; resonance, critical speeds of shafts.

Technical drafting

Engineering drawing practice; Indian standards for technical drawing. Machine Elements Basic concepts of machine elements and their design.

FLUID MECHANICS AND THERMAL SCIENCES Fluid Mechanics

Fluid properties; viscous flow of incompressible fluids; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; flow through pipes, head losses in pipes, bends etc.

Heat-Transfer

Modes of heat transfer; one dimensional heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, radiative heat transfer, black and grey surfaces, shape factors; 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. Sterling cycle.

Refrigeration and air-conditioning

Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air psychrometric chart, basic psychrometric processes.

Turbo machinery

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

Load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powdermetallurgy

Joining

Physics of welding, brazing and soldering; adhesive bonding;

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.

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.

SOME CURRENT TRENDS IN DESIGN AND MANUFACTURING

Mechatronics System Design

Pneumatic and hydraulic systems; Electro-pneumatic and electro-hydraulic systems; Pneumatic, hydraulic and electric motors and actuators; Concepts of microcontrollers, Feedback devices; Point-to-point, continuous-path and servo control; Types of CNC machines and robots. Programmable logic controllers; CNC and robot programming. Some current developments in modern machine tools, robotics, mechatronics; Basic topics related to micro-electro mechanical systems (MEMS).

Computer Integrated Manufacturing

Basic concepts of CAD/CAM and their integration tools. Exchange of product design and manufacturing data; CNC and robot programming methods. CAD/CAM Software and Virtual Product Development; Rapid Manufacturing Technologies; Concepts of Machine vision and Jigless manufacturing;

Computer Aided Engineering

Finite Element Methods; Computational Fluid Dynamics; Mechanical Systems Simulation; Tools for conventional mechanisms and MEMS design.

Automotive Engineering

Development in Bio-fuels, other alternative fuels and hydrogen as future fuel; Emission standards; Electronic injection systems; Passenger comfort and safety devices; Indian auto industry and Automotive vehicles in Indian market.