**SVKM's NMIMS Global University**

**PhD Entrance Syllabus**

# Mechanical Engineering – Paper II

## Unit 1: Engineering Mathematics

Matrix algebra, systems of linear equations, Taylor series, Fourier series; First order differential equations (linear and nonlinear); higher order linear differential equations with constant coefficients; initial and boundary value problems; Integration by trapezoidal and Simpson's rules;

## Unit 2: Applied Mechanics and Design

**Mechanics of Materials**: Stress and strain, elastic constants, Poisson's ratio; shear force and bending moment diagrams.

**Theory of Machines**: Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; gyroscope.

**Machine Design**: Design for static and dynamic loading; failure theories; fatigue strength, S-N diagram; principles of the design of machine elements such as gears, rolling contact bearings, brakes and clutches.

## Unit 3: Fluid Mechanics and Heat Transfer

**Fluid Mechanics**: Fluid properties; stability of floating bodies; Kinematics of Flow (Types of Fluid Flow, Continuity Equation); Fluid Dynamics (Bernoulli's equation & its applications); flow through pipes, head losses in pipes, bends and fittings.

**Heat-Transfer**: Modes of heat transfer; 1D heat conduction-thermal resistance and electrical analogy, fins; transient heat conduction-lumped parameter system, dimensionless number for convection, Heat Exchanger – LMTD and NTU method; radiative heat transfer, Stefan- Boltzmann & Wien's law, view factors, radiation shields.

**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.

**Applications**: Air compressors; vapour power and gas power cycles, Air-standard Otto, Diesel and dual cycles. Vapour Compression & Vapour Absorption refrigeration cycle; psychrometric chart, basic psychrometric processes.

## Unit 4: Materials and Manufacturing

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

**Casting, Forming and Joining Processes**: Different types of castings, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working 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.

**Metrology and Inspection**: Limits, fits and tolerances; linear and angular measurements; comparators; concepts of coordinate-measuring machine (CMM).

## Unit 5: Industrial Engineering

**Production Planning and Control**: Forecasting models, aggregate production planning, scheduling, materials requirement planning; lean manufacturing.

**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.

## REFERENCE BOOKs:

1. Cengel Y. A., and Boles M. A. (2006), *Thermodynamics - An Engineering Approach*, 5th Edition, Tata McGraw Hill.
2. Kodgire V. D. and Kodgire S. V., *Material Science and Metallurgy for Engineers*, Everest Publishing House, Pune, 24th edition, 2008.
3. Kalpakjian S. and Schmid S. R., (2009), *Manufacturing Engineering and Technology*, 6th Edition, Addison Wesley Longman (Singapore) Pte. India Ltd.,
4. Rattan S. S., *Theory of Machines*, Tata McGraw Hill, New Delhi.
5. Ramamrutham S., *Strength of Materials*, Dhanpat Rai and Sons, New Delhi.
6. Sastri S. S., (2003) "*Introductory Methods of Numerical Analysis*", 3rd Edition, Prentice Hall of India, New Delhi.
7. Bhandari V. B. (2021), *Design of Machine Elements*, 5th Edition, McGraw Hill Education (India) Private Limited, New Delhi.
8. Bansal R. K. (2010), *A Textbook of Fluid Mechanics & Hydraulic Machines*, Laxmi Publications, New Delhi.
9. Cengel Y. and Ghajar A. J. (2020), *Heat and Mass Transfer: Fundamentals & Applications in SI Units*, 6th Edition, McGraw Hill Education (India) Private Limited, New Delhi.