

# DEPARTMENT OF MECHANICAL ENGINEERING

Aligarh Muslim University, Aligarh

## Syllabus for Ph.D. Entrance Test (2017-18)

### PART – I : RESEARCH METHODOLOGY

(40 Marks)

#### SECTION – A

#### Multiple Choice Questions

**Writing Skills:** Tenses, Parts of Speech, Clauses, Subject-verb agreement, Idioms and Phrases, reading comprehension, Word Meaning, Synonyms-Antonyms, Hyponyms.

#### Logical and Analytical Reading

**Programming Skills:** Data types, Assignments, Conditional Statement, Branching and Looping, Input and Output Statements.

**Mathematics and Statistics:** Algebra, Ordinary Differential equations (ODE), Numerical Analysis, Real and Complex Analysis, Vector Analysis, Measure of Central Tendency, Probability Distribution Function.

### PART – II : MECHANICAL ENGINEERING COURSES

(10 Marks)

(From all three Specializations given below)

#### SECTION – B

#### Subjective Type Questions

(30 Marks)

#### 1. MACHINE DESIGN

**Engineering Mechanics:** Free-body diagrams and equilibrium, 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 Solids:** Stress and Strain, elastic constants, Poisson's ratio, Mohr's circle for plane stress and plane strain, thin and thick cylinders, rotating ring and discs, 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.

**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.

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

**Design of Machine Elements:** 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.

## **2. THERMAL ENGINEERING**

**Fluid Mechanics:** Fluid properties, fluid statics, 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.

**Heat Transfer:** 1D heat conduction, resistance concept and electrical analogy, heat transfer through fins, unsteady heat conduction, thermal boundary layer, free and forced convection, condensation and boiling, heat exchanger performance, LMTD and NTU methods, radiative heat transfer, Stefan-Boltzmann Law, Wien's displacement Law, black and grey surfaces, view factors, radiation network analysis, radiation shields.

**Thermodynamics:** Thermodynamics systems and processes, properties of pure substances, behaviour of ideal and real gases, zeroth and first laws of thermodynamics, calculation of work and heat in various processes, second law of thermodynamics, availability and irreversibility, thermodynamic 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, psychrometric processes. *Turbomachinery:* Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan Turbines.

## **3. INDUSTRIAL AND PRODUCTION ENGINEERING**

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

**Casting, Forming and Joining Processes:** Design and Principles of castings, Plastic deformation, fundamentals of hot and cold working processes, metal forming processes, principles of powder metallurgy, principles of welding and other joining processes.

**Machining and Machine Tool Operations:** Mechanics of Machining, machine tools, cutting tools and materials, non-traditional machining processes, design of jigs and fixtures.

**Metrology and Inspection:** Limits, fits and tolerances, linear and angular measurements, comparators, gauge design, interferometry, tolerance and analysis in manufacturing and assembly.

**Computer Integrated Manufacturing:** Concepts of CAD/CAM and their integration tools.

**Production Planning and Control:** Forecasting, production, planning, scheduling, materials requirement planning.

**Inventory Control:** Deterministic models, safety stock inventory control systems.

**Operations Research:** Optimization Techniques, Network flow models.