



TEERTHANKER MAHAVEER UNIVERSITY

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Delhi Road, Moradabad (U.P.)

SYLLABUS FOR RESEARCH APTITUDE TEST IN MECHANICAL ENGINEERING

The syllabus for Research Aptitude Test (RAT) in Mechanical is divided in two parts viz. Part A & Part B described below:

PART – A

Part A of the RAT shall be designed to assess the research skills/aptitude of the candidate consisting of questions from the following areas:

- 1. Research Methodology:** meaning, characteristics, and ethical issues in research; types of research; research methods
- 2. Logical Reasoning:** arguments, deductive and inductive research; logical and Venn diagram; inferences; analogies.
- 3. Data Interpretation:** interpretation of data; mapping and analysis of data, tools for data analysis; quantitative and qualitative research.
- 4. General Awareness about Basic Science:** basic science up to the level of SSC.
- 5. Mathematical Reasoning:** number series, letter series, codes; relationships, classification.

PART – B

Part-B of RAT is designed to assess subject specific knowledge of the candidate covering the syllabus given as below:

Mechanical Engineering Design: Load analysis; modes of failure; theories of failure; safety factors; reliability; selection of materials; design of machine elements subjected to static and fatigue loading; shafts; gears; bearings, etc.; design against creep and fracture.

Mechanisms: Kinematic and dynamic analysis & synthesis of planar and spatial mechanisms; Euler-Savary equation; cubic of stationary curvature; numerical methods in kinematics and dynamics.

Vibrations: Free, damped and forced vibrations of single degree, multi degree and continuous mechanical systems; vibration measuring instruments; vibration isolation; numerical methods; transient and non-linear vibrations.

Production Engineering: Mechanical Behavior of metals, Advanced casting processes, Advanced finishing processes Theories of fracture creep and fatigue, Smart Materials, Advanced manufacturing processes Unconventional Machining Processes, Fundamentals of automated production, Flexibility, Computer controlled machines, Computer aided process planning, Computer Integrated Manufacturing, Flexible Manufacturing Systems.

Industrial Engineering: Statistical Process Control, Total Quality Management, Enterprise Resource Planning, Supply Chain Management, Inventory Control, MRP. Business Process Redesign, Value Engineering, Materials Handling, Environmental issues and Green Practices, Technology Management, Reliability, Experimental Design, Statistical tools and application. Project Management, Dynamic Programming and Non Linear programming, Game Theory, Decision tree, Monte Carlo simulation, Ergonomics.

Thermodynamics: Laws of thermodynamics, Entropy, Irreversibility and Availability, Behaviour of ideal and real gases, Calculation of work and heat in ideal processes. Analysis of thermodynamics cycles related to energy conversion.

Fluid Mechanics: Fluid Mechanics: Fluid properties; Control-volume analysis of mass, momentum and energy; Equations of continuity, momentum and energy, Bernoulli's equation, Boundary layer theory; Flow through pipes, Laminar and Turbulent Flow and Compressible flow.

Heat Transfer: Modes of heat transfer, Resistance concept, unsteady heat conduction, Fins, Effect of turbulence, Radiative heat transfer, black and grey surfaces shape factors, network analysis, Heat exchangers.

I.C. Engines: Requirements and suitability of fuels in IC engines, Normal and abnormal combustion in SI and CI engines, Engine performance calculations, Turbocharging, Supercharging, Pollutant formation and control methods, Emission norms, Stratified charge engines, Homogenous charge compression ignition (HCCI) engines, Zero emission vehicles.

Refrigeration and air-conditioning: Refrigeration system, expansion devices, condensers and evaporators, Psychrometric chart, Vapor Absorption system, Humidification, Dehumidification, Adiabatic mixing, Multistage multi evaporation system, Three fluid absorption system, Solar refrigeration system.

Energy Conversion System: Basic cycles related to energy conversion systems, Combined cycle, Cogeneration system, Steam generator, Steam turbine, Gas turbines, Nuclear power plant, Hydroelectric plant.

Gas Dynamics: Basic equations of fluid flow, Wave propagation, Shock waves, Expansion waves, Rayleigh line, Fanno line, Rarefied Gas Dynamics, Measurement in compressible flow.