SYLLABUS FOR TECHNICAL QUESTIONS IN MECHANICAL ENGINEERING
[100 Marks: 50 Questions]

Applied Mechanics and Design Engineering Mechanics

Engineering Mechanics: Free-body diagrams and equilibrium; friction and its applications including rolling friction, belt-pulley, brakes, clutches, screw jack, wedge, vehicles, etc.; trusses and frames; virtual work; kinematics and dynamics of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations; Lagrange's equation.

Mechanics 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; concept of shear centre; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

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.

Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid properties; fluid statics, forces on submerged bodies, stability of floating bodies; 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, head losses in pipes, bends and fittings; basics of compressible fluid flow

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, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; 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

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; thermodynamic property charts and tables, 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 chart, basic psychrometric processes. Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines; steam and gas turbines.

Materials, Manufacturing and Industrial Engineering

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; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming 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; economics of machining; principles of non-traditional machining processes; principles of work holding, jigs and fixtures; abrasive machining processes; NC/CNC machines and CNC programming.

Metrology and Inspection: Limits, fits and tolerances; linear and angular measurements; comparators; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly; concepts of coordinate-measuring machine (CMM).

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools; additive manufacturing.

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.

Test of Reasoning [15 Marks: 15 Questions]

Logical Reasoning

Statement and Conclusion, Statement and Assumptions, Statement and Arguments, Statement and Course of Action, Cause and Effect, Analytical Decision Making

Seating Arrangement

Circular Arrangement, Linear Arrangement (Single and Double Rows), Square and Rectangular Arrangements, Floor Puzzles, Box-Based Puzzles

Puzzles

Scheduling Puzzles, Blood Relations-Based Puzzles, Ranking and Order Puzzles, Age-Based Puzzles, Day/Month-Based Puzzles

Blood Relations

Family Tree and Relationship Chains, Coded Relationships.

Syllogisms

Categorical Syllogisms, Advanced Syllogisms (Reverse Syllogisms), Venn Diagram Applications in Syllogisms

Coding-Decoding

Alphanumeric Coding, Letter Coding, Number Coding, Symbol-Based Coding

Direction Sense Test

Cardinal Directions (North, South, East, West), Complex Directions with Turning and Distances

Quantitative Aptitude [15 Marks: 15 Questions]

Data Interpretation

- **Tabular Data Interpretation**: Interpretation of tables and data sets.
- **Line Graph**: Data representation and analysis using line graphs.
- **Bar Graph**: Interpretation of data presented in bar graphs.
- **Pie Chart**: Calculations based on data presented in pie charts.
- **Caselets**: Data interpretation with paragraph-based information.
- **Mixed Graphs**: Combining different types of graphs in a single question.
- **Radar Graph (Spider Web)**: Less common but may appear.

Number Series

- **Missing Number Series**: Finding the missing term in a given series.
- **Wrong Number Series**: Identifying the incorrect term in a series.

Simplification and Approximation

- Questions based on basic mathematical operations to simplify expressions.
- Approximation questions require choosing the closest answer.

Quadratic Equations

- Solving quadratic equations to find roots.
- Comparison of roots between two quadratic equations.

Data Sufficiency

- Problems with multiple statements where you determine if the given data is sufficient to answer the question.

Arithmetic Topics

- **Percentages**: Basic calculations, profit and loss, and discounts.
- **Ratio and Proportion**: Problems based on direct and inverse proportions.

- **Average**: Calculating averages for different scenarios.
- **Simple Interest and Compound Interest**: Interest calculations over time.
- **Profit and Loss**: Calculation of gains, losses, and discounts.
- **Time and Work**: Problems involving work completion, efficiency, and combined efforts.
- **Time, Speed, and Distance**: Calculations with speed, distance, and time; includes boats and trains.
- **Mixtures and Alligations**: Mixing solutions, costs, and ratios.
- **Mensuration**: Basic geometry, areas, volumes of shapes, and perimeters.
- **Partnerships**: Sharing profits based on investments.
- **Probability**: Basic probability calculations and event outcomes.
- **Permutation and Combination**: Arrangement and selection problems.

Mathematical Inequalities

- Problems requiring the comparison of quantities using inequalities.

Miscellaneous Word Problems

- These cover real-life scenarios and test conceptual understanding.

General Awareness [15 Marks: 15 Questions]

Current Affairs

- Recent events of national and international importance
- Awards and Honors (Padma Awards, Nobel Prizes, etc.)
- Sports (major tournaments, winners, records)
- Government schemes and policies
- Important Summits and Conferences
- Economic and Banking Awareness (recent developments in banking and finance)
- Important Days and Themes

Indian History

- **Ancient History**: Indus Valley Civilization, Vedic Period, Maurya and Gupta Empires
- **Medieval History**: Delhi Sultanate, Mughal Empire, Bhakti and Sufi Movements
- **Modern History**: British Rule, Revolt of 1857, Indian National Movement, Independence

Geography

- **Physical Geography**: Landforms, Atmosphere, Climate, and Natural Vegetation
- **Indian Geography**: Rivers, Mountains, Plateaus, Deserts, Soil, Forests
- **World Geography**: Continents, Countries, Capitals, and prominent physical features

Indian Polity and Constitution

- **Constitutional Framework**: Preamble, Fundamental Rights and Duties, Directive Principles
- **Union and State Government**: Structure, Roles, and Functions of Executive, Legislature, and Judiciary
- **Important Amendments and Articles**: Key constitutional amendments and articles
- **Political System**: Panchayati Raj, Election Commission, Local Governance

Economics and Finance

- **Basic Concepts**: Micro and Macro Economics, Demand and Supply, National Income
- **Indian Economy**: Economic Reforms, Planning in India, Economic Terminology
- **Banking and Finance**: RBI, Money Market, Inflation, Economic Policies
- **Budget and Fiscal Policies**: Key points from the Union Budget and Economic Surveys

Science and Technology

- **Biology**: Human Body, Health and Diseases, Important Biological Terms
- **Chemistry**: Basics of Elements and Compounds, Acids and Bases, Metals and Non-Metals
- **Physics**: Laws of Motion, Work and Energy, Heat, Light, Sound, Electricity and Magnetism
- **Computer Awareness**: Basic terminology, Networking, Internet, Hardware and Software
- **Inventions and Discoveries**: Key scientific and technological developments

Environment and Ecology

- **Ecological Concepts**: Biodiversity, Conservation, Ecosystem, Food Chain
- **Environmental Issues**: Pollution, Climate Change, Global Warming, Renewable and Non-Renewable Resources
- **Important Organizations and Conventions**: UNEP, Kyoto Protocol, Paris Agreement

General Knowledge

- **Important Dams, Rivers, and National Parks**
- **Important Organizations**: UN, WHO, WTO, IMF, World Bank
- **Space Research**: Recent developments in ISRO, NASA, and space missions.

English Language [15 Marks: 15 Questions]

Reading Comprehension

- Passage comprehension with questions on main ideas, themes, and details
- Inference-based questions
- Vocabulary questions (synonyms, antonyms) based on the passage
- Tone of the passage

Grammar and Vocabulary

- **Error Spotting**: Identifying grammatical errors in sentences
- **Sentence Correction**: Correcting grammatically incorrect sentences
- **Fill in the Blanks**: Choosing the right words to complete sentences (single and double fill-in-the-blanks)
- **Cloze Test**: Passage with blanks where you choose the most suitable word for each blank
- **Phrase Replacement**: Replacing phrases in sentences to make them grammatically correct

Sentence Rearrangement (Para Jumbles)

- Arranging jumbled sentences in the correct order to form a coherent paragraph
- Identifying the correct opening and closing sentences in a set of jumbled sentences

Synonyms and Antonyms

- Questions based on commonly used synonyms and antonyms
- Word replacement questions to test vocabulary strength

Idioms and Phrases

- Understanding and applying the meaning of commonly used idioms and phrases
- Questions based on idiomatic usage in sentences

Word Association and Usage

- **Word Pairing**: Identifying relationships between pairs of words
- **Homonyms and Homophones**: Recognizing words that sound similar but have different meanings
- **Spell Check**: Questions based on identifying misspelled words

Sentence Completion and Paragraph Completion

- Choosing the most appropriate sentence or word to complete a paragraph
- Filling gaps in sentences to make logical and grammatically correct statements

Verbal Ability

- Questions based on verbal reasoning and critical thinking
- Questions on understanding of sentence meaning and logical progression