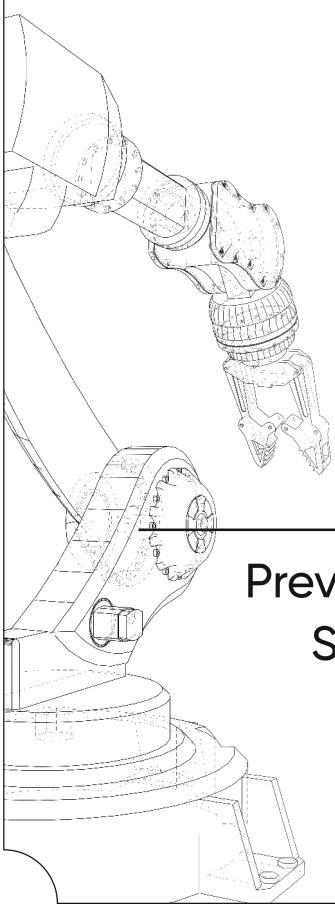
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ESE - 2027

UPSC MAINS EXAMINATION

MORE THAN 25 Years of Solutions 2000-2026



MECHANICAL ENGINEERING

Previous Years Conventional Questions with Solutions, Subjectwise & Chapterwise

Paper-II (Conventional)

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Foreword

In UPSC Engineering Services, Conventional Papers have 54.5% weightage in the entire process of written test.



In Paper - II of Mechanical Engineering Nine subjects are included as follows:

01. Production Engineering
02. Strength of Materials
03. Theory of Machines
04. Machine Design
05. Industrial Engineering
06. Engineering Materials
07. Mechatronics & Robotics
08. Engineering Mechanics
09. Maintenance Engineering

The following approach is advisable to secure maximum marks.

- The solution to any question shall have the following appropriate steps generally. Steps will also have due weightage.
  (a) The data given
  (b) The appropriate figure, if applicable, with parts labeled properly
  (c) The concept on which the problem is being solved
  (d) The relevant formulae with standard notations and abbreviations. Incase the paper setter asks to solve the question from the fundamentals, necessary derivations shall be done. Otherwise 70% of marks one has to lose. If the question carries more marks like 10 to 20 marks detailed analysis is compulsory to score high. If the question carries less marks (<8) the formulae with abbreviations and concept may be sufficient. In any case, the assumptions made shall be written clearly while solving a problem.
- The neatness and presentation of solutions will have 5% marks.
- Note that all parts of a question shall be answered together.
- Using short sentences and brevity in expressing the content is appreciated.
- Practice of numerical problems using calculator is very much essential instead of reading merely.

* **Try to understand and practice the solutions keeping in view QCAB format**

The solutions are prepared with utmost care. In spite of this there may be some typographical mistakes or improper sequence. The student is requested to inform us regarding errors, if any to aceenggpublications@gmail.com. ACE Engineering Publications will be grateful in this regard.

Thanks to all the professors who co-operated in the preparation of this booklet. Thanks to the Academic Assistants and Data Entry section in the design of this booklet.

With best wishes to all those who wish to go through the following pages.

Y.V. Gopala Krishna Murthy,
M Tech. MIE,
Chairman & Managing Director,
ACE Engineering Academy,
ACE Engineering Publications.
Frost Interactive Service Pvt. Ltd. (ACE ONLINE).

Syllabus for MECHANICAL ENGINEERING (ME)

PAPER – II

1. **Engineering Mechanics:**

   Analysis of System of Forces, Friction, Centroid and Centre of Gravity, Dynamics; Stresses and Strains-Compound Stresses and Strains, Bending Moment and Shear Force Diagrams, Theory of Bending Stresses-Slope and deflection-Torsion, Thin and thick Cylinders, Spheres.

2. **Engineering Materials:**

   Basic Crystallography, Alloys and Phase diagrams, Heat Treatment, Ferrous and Non Ferrous Metals, Non metallic materials, Basics of Nano-materials, Mechanical Properties and Testing, Corrosion prevention and control

3. **Mechanisms and Machines (TOM) :**

   Types of Kinematics Pair, Mobility, Inversions, Kinematic Analysis, Velocity and Acceleration Analysis of Planar Mechanisms, CAMs with uniform acceleration and retardation, cycloidal motion, oscillating followers; Vibrations –Free and forced vibration of undamped and damped SDOF systems, Transmissibility Ratio, Vibration Isolation, Critical Speed of Shafts. Gears – Geometry of tooth profiles, Law of gearing, Involute profile, Interference, Helical, Spiral and Worm Gears, Gear Trains- Simple, compound and Epicyclic; Dynamic Analysis – Slider – crank mechanisms, turning moment computations, balancing of Revolving & Reciprocating masses, Gyroscopes –Effect of Gyroscopic couple on automobiles, ships and aircrafts, Governors.

4. **Design of Machine Elements (MD) :**

   Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as riveted, welded and bolted joints. Shafts, Spur gears, rolling and sliding contact bearings, Brakes and clutches, flywheels.

5. **Manufacturing, Industrial and Maintenance Engineering:**

   Metal casting-Metal forming, Metal Joining, Machining and machine tool operations, Limits, fits and tolerances, Metrology and inspection, computer Integrated manufacturing, FMS,
   Production planning and Control, Inventory control and operations research - CPM-PERT. Failure concepts and characteristics-Reliability,
   Failure analysis, Machine Vibration, Data acquisition, Fault Detection, Vibration Monitoring, Field Balancing of Rotors, Noise Monitoring, Wear and Debris Analysis, Signature Analysis, NDT Techniques in Condition Monitoring.

6. **Mechatronics and Robotics:**

   Microprocessors and Microcontrollers: Architecture, programming, I/O, Computer interfacing, Programmable logic controller. Sensors and actuators, Piezoelectric accelerometer, Hall effect sensor, OpticalEncoder, Resolver, Inductosyn, Pneumatic and Hydraulic actuators, stepper motor, Control Systems- Mathematical modeling of Physical systems, control signals, controllability and observability. Robotics, Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics; Homogeneous Coordinates and Arm Equation of four Axis SCARA Robot

Weightage of Subjects in Engineering Services Examination

Mechanical Engineering (2017 – 2026)

PAPER - II (Conventional)

Name of the Subject	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Strength of Materials	52	42	62	64	32	52	72	44	96	52
Theory of Machines	96	96	94	84	104	84	84	104	72	104
Machine Design	80	60	72	40	64	72	52	72	72	92
Production Engineering	62	84	66	52	52	52	64	82	60	52
Industrial Engineering	32	42	40	72	52	32	12	22	32	22
Engineering Materials	52	42	52	52	32	32	32	32	52	22
Mechatronics and Robotics	84	52	72	52	92	92	92	92	64	92
Engineering Mechanics	12	42	12	52	40	32	32	20	20	12
Maintenance Engineering	10	20	10	12	12	32	40	12	12	32
Total No. Marks	**480**	**480**	**480**	**480**	**480**	**480**	**480**	**480**	**480**	**480**

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