In this text-book, the approach is to study systematically the laws of Mechanics and their application to engineering problems. The outline of the book is:

- Chapters 1 and 2 discuss Introduction of Mechanics; Fundamental Concepts and Principles; Scalars, Vectors and Tensors; SI Units, Vector Algebra, etc.
- Chapter 3 to 10 consist the study of Mechanics of Rigid Bodies: Fundamentals of Statics, Forces and Force systems such as coplanar concurrent force systems; Moments; Parallel Forces and Couples; Spatial forces; Reactions etc.
- Chapter 11 deals in Properties of Lines, Areas and Solids.
- Chapter 12 and 13 discuss application of the connected bodies viz., trusses, frames and mechanisms.
- Chapter 14 gives problems of statics in Graphics Statics
- Chapter 15 and 16Moments of Inertia of Areas and Masses; Friction respectively.
- Chapters 17 to 21 include the study of Dynamics and Kinematics such as — the motion of the particles, etc.
- Chapters 22to 29 deal with topics on Kinetics of Particles such as Laws of Motion: Work and Energy; Impulse and Momentum. Special Topics such as Central Force Motion and Collisions; Kinetics of Systems of Particles, Kinetics of Rigid Bodies; Motion of Vehicles are also covered.
- Chapters 30to 38 deal with topics such as Balancing and Rotating Masses; Virtual Work; The Catenary; Belt and Rope Drive; Toothed Gearing; Lifting Machine; Mechanical Vibration; Hydrostatics and Impact of Jets.

This book now contains:
- 904 Neatly drawn figures; 56 Useful tables; 453 Solved examples; 670 Unsolved examples at the end of chapters.

It is hoped that this edition should prove extremely useful to students of Engineering reading for Degree Examinations of all the Universities of India, Diploma Examinations conducted by various Boards of Technical Education, Certificate Courses, as well as for the U.P.S.C., G.A.T.E., A.M.I.E., I.E.S. and other similar competitive and professional examinations. It should also prove of great interest and practical use to the practising engineers.

Also available

WORKED EXAMPLES OF APPLIED MECHANICS

By Dr. H. J. Shah

651 Solutions of the unsolved examples given at the end of all 38 chapters from the text book “APPLIED MECHANICS” with 480 neat and self-explanatory drawings.

Size : 170 mm × 240 mm
Pages : 580 + 08 = 588

Catalogue | Checklist
Chapter 1 INTRODUCTION
1-1. Mechanics
1-2. Fundamental concepts
1-3. Scalars, vectors and tensors
1-4. Fundamental principles
1-5. System of units: SI units
1-6. Using SI units
Questions I

Chapter 2 VECTORS
2-1. Vectors
2-2. Basic operations with vectors
2-3. Components, unit vectors and position vector
2-4. Vector algebra: Dot product
2-5. Vector algebra: Cross product
2-6. Triple product of vectors
Exercise II

Chapter 3 COPLANAR CONCURRENT FORCES
3-1. Forces and force systems
3-2. Principle of transmissibility
3-3. Resultant of a force system
3-4. Resultant of two coplanar concurrent forces
3-5. Resultant of several coplanar forces acting at a point: Law of polygon of forces
3-6. Resolution of a force
3-7. Resultant of a coplanar concurrent force system: Resolution method
Examples III

Chapter 4 MOMENTS
4-1. Moment of a force
4-2. Principle of moments: Varignon’s theorem
4-3. Coplanar applications
4-4. Levers
4-5. A simple pulley
Examples IV

Chapter 5 PARALLEL FORCES AND COUPLES
5-1. Parallel force system
5-2. Couples
5-3. Equivalent couples
5-4. Addition of couples
5-5. Operations with couples
5-6. Equivalent systems of forces
5-7. Equilibrant systems of vectors
Examples V

Chapter 6 RESULTANT OF COPLANAR FORCE SYSTEMS
6-1. Introduction
6-2. Resultant of parallel force system
6-3. Centre of parallel forces
6-4. Resultant of a general coplanar force system
6-5. Concentrated and distributed loads
Examples VI

Chapter 7 SPATIAL FORCES
7-1. Concurrent forces in space
7-2. Moment of a force
7-3. Resultant of spatial force system
7-4. Wrench resultant
Examples VII

Chapter 8 EQUILIBRIUM OF COPLANAR FORCE SYSTEMS
8-1. Equilibrium
8-2. Equilibrium of a particle
8-3. Resultant and equilibrant
8-4. Principle of action and reaction
8-5. Free body and free body diagram
8-6. Tensions of strings
8-7. Equilibrium of three forces acting on a particle: Lami’s theorem
8-8. Equilibrium of a particle under three forces acting on it
8-9. External and internal forces
8-10. Tension and compression
8-11. Connected bodies
8-12. Equilibrium of a rigid body
8-13. Conditions of equilibrium for a system of coplanar forces acting on a body
8-14. Types of supports
8-15. Solution of problems
Examples VIII

Chapter 9 REACTIONS
9-1. Axial and transverse forces
9-2. Structural members
9-3. Types of beams
9-4. Reactions by proportions
9-5. Reactions by equations of statics: Principle of super-position
9-6. Determine and indeterminate beams/structures
Examples IX

Chapter 10 EQUILIBRIUM OF SPATIAL FORCE SYSTEMS
10-1. Equilibrium of spatial force systems
Examples X

Chapter 11 PROPERTIES OF LINES, AREAS AND SOLIDS
11-1. Introductory
11-2. Centre of gravity
11-3. Centre of mass
11-4. Centroids
11-5. First moment of an element of line and area
11-6. First moment of a line segment and a finite area
11-7. Centroids of lines and areas
11-8. Centroids of symmetrical lines and areas
11-9. Centroids by integration
11-10. Summary of centroids of common figures
11-11. Centroids of composite lines and areas
11-12. Theorems of Pappus — Guldinus
11-13. Centroid of volumes
Examples XI

Chapter 12 TRUSSES
12-1. Engineering applications of connected bodies
12-2. Introductory
12-3. Assumptions made in the analysis of a truss
12-4. Truss notations
12-5. Common types of trusses
12-6. Analysis of a truss
12-7. Method of joints
12-8. Method of sections
12-9. Determinateness of a truss
12-10. Truss with two hinges
12-11. Space trusses
Examples XII

Chapter 13 FRAMES AND MECHANISMS
13-1. Frames and mechanisms
Examples XIII

Chapter 14 GRAPHIC STATICS
14-1. Introductory
14-2. Basic concepts
14-3. Conditions of equilibrium of a point
14-4. Three force equilibrium of coplanar, non-concurrent, non-parallel forces
14-5. Resultant of non-concurrent, non-parallel forces: Funicular polygon
14-6. Resultant of parallel forces
14-7. Parallel forces: Centroid problems
14-8. Graphical conditions of rigid body equilibrium
14-9. Reactions of beams and trusses
14-10. Graphical methods applied to trusses
14-11. Force diagrams for individual joints of a truss
14-12. The Maxwell diagram
14-13. Method of substitution
14-14. Truss with two hinges with inclined loads
Examples XIV
### Applied Mechanics

#### Detailed Contents

**Chapter 15 Moments of Inertia**
- 15-1. Introduction
- 15-2. Definitions
- 15-3. Radius of gyration
- 15-4. Parallel axis theorem
- 15-5. Moment of inertia by integration
- 15-6. Moment of inertia of composite areas
- 15-7. Graphical method for first and second moments of a plane section about an axis in its plane

**Chapter 16 Friction**
- 16-1. Introduction
- 16-2. Types of friction
- 16-3. Characteristics of dry friction
- 16-4. Angle of friction: Cone of friction
- 16-5. Angle of repose
- 16-6. Types of problems
- 16-7. Equilibrium on a rough inclined plane

**Chapter 17 Rectilinear Motion of a Particle**
- 17-1. Motion of a particle
- 17-2. Speed
- 17-3. Velocity
- 17-4. Definitions
- 17-5. Motion under constant acceleration
- 17-6. Motion under gravity

**Chapter 18 Motion Under Variable Acceleration**
- 18-1. Motion under variable acceleration
- 18-2. Vector calculus

**Chapter 19 Relative Motion of a Particle**
- 19-1. Relative motion of a particle
- 19-2. Motion of connected particles

**Chapter 20 Curvilinear Motion of a Particle**
- 20-1. Introductory
- 20-2. Velocity, Acceleration and Hodograph
- 20-3. Rectangular components of curvilinear motion
- 20-4. Normal and tangential components: Intrinsic co-ordinates
- 20-5. Radial and transverse components: Cylindrical co-ordinates
- 20-6. Angular motion of a line
- 20-7. Circular motion of a particle
- 20-8. Simple Harmonic Motion
- 20-9. Projectiles: Motion in a vertical plane under gravity
- 20-10. Motion of a projectile on an inclined plane

**Chapter 21 Kinematics of Rigid Bodies**
- 21-1. Introduction
- 21-2. Translation
- 21-3. Fixed axis rotation
- 21-4. General plane motion
- 21-5. Absolute motion analysis
- 21-6. Relative motion analysis
- 21-7. Instantaneous centre: Centrodes

**Chapter 22 Kinematics of Particles: Laws of Motion**
- 22-1. Introduction
- 22-2. Inertia and mass: Inertia
- 22-4. Newton’s second law
- 22-5. Inertial frame
- 22-6. Equations of motion
- 22-7. Constant force acting on a particle
- 22-8. Variable force acting on a particle
- 22-9. Motion of a lift
- 22-10. Motion on a rough inclined plane
- 22-11. Motion of connected bodies
- 22-12. D’Alembert’s principle: Dynamic equilibrium
- 22-13. Curvilinear motion
- 22-14. Circular motion
- 22-15. Newton’s law of gravitation

**Chapter 23 Kinetics of Particles: Work and Energy**
- 23-1. Introductory
- 23-2. Work done by a force
- 23-3. Standard cases
- 23-4. Power and efficiency
- 23-5. Energy
- 23-6. Conservative forces
- 23-7. Principle of conservation of energy
- 23-8. Total mechanical energy
- 23-9. Extrinsic forces

**Chapter 24 Kinetics of Particles: Impulse and Momentum**
- 24-1. Linear momentum
- 24-2. Linear impulse
- 24-3. Variable force with time
- 24-4. Impulsive forces
- 24-5. Angular momentum
- 24-6. Angular impulse

**Chapter 25 Central Force Motion**
- 25-1. Introductory
- 25-2. Central force motion
- 25-3. Trajectory of a particle under a central force
- 25-4. Launching of a space vehicle
- 25-5. Escape velocity: Particle orbits
- 25-6. Periodic time of an orbit
- 25-7. Communication satellite
- 25-8. Kepler’s laws of planetary motion

**Chapter 26 Collisions**
- 26-1. Collision of two bodies: Impact
- 26-2. Definitions
- 26-3. Phenomenon of impact
- 26-4. The general condition
- 26-5. Collision of perfectly elastic bodies
- 26-6. Inelastic collisions
- 26-7. Collision of partially elastic bodies
- 26-8. Oblique impact on a smooth horizontal plane
- 26-9. Oblique impact of two smooth spheres
# Applied Mechanics

## Detailed Contents

### Chapter 27 Kinetics of Systems of Particles
- 27-1. Introduction
- 27-2. Application of law of motion for system of particles
- 27-3. Principle of motion of mass centre
- 27-4. Work-energy
- 27-5. Linear and angular momentum of a system of particles
- 27-6. Principle of impulse and momentum for a system of particles

Examples XXVII

### Chapter 28 Kinetics of Rigid Bodies
- 28-1. Introduction
- 28-2. Translation
  - ROTATION
- 28-3. Rotational motion
- 28-4. Work done by a couple: Kinetic energy of rotation
- 28-5. Impulse and momentum
  - PLANE MOTION
- 28-6. Wheel rolling without slipping

SPECIAL TOPICS
- 28-7. Flywheels
- 28-8. Centre of Percussion

Examples XXVIII

### Chapter 29 Motion of Vehicles
- 29-1. Motion of vehicles
- 29-2. Tractive resistance
- 29-3. Tractive force
- 29-4. Driving torque
- 29-5. Maximum possible tractive effort
- 29-6. Power to drive a vehicle
- 29-7. A truck rolling down a rough inclined plane
- 29-8. Motion of a truck along level track
- 29-9. Motion of a truck going round a curve
- 29-10. Banking a curve: Super-elevation

Examples XXIX

### Chapter 30 Balancing of Rotating Masses
- 30-1. Static and Dynamic balance
- 30-2. Balancing of several masses in the same plane of revolution
- 30-3. Dynamical loads at bearings
- 30-4. Balancing of a mass by two masses in different planes of revolution

Examples XXX

### Chapter 31 Virtual Work
- 31-1. Introductory
- 31-2. Principle of virtual work

Examples XXXI

### Chapter 32 The Catenary
- 32-1. The Catenary
- 32-2. The parabolic chain
- 32-3. The length of the cable

Examples XXXII

### Chapter 33 Belt and Rope Drive
- 33-1. Belt drive
- 33-2. Velocity ratio
- 33-3. Compound belt drive
- 33-4. Length of belt: Open drive
- 33-5. Length of belt: Crossed drive
- 33-6. Transmission of power
- 33-7. Centrifugal tension
- 33-8. Optimum speed for maximum power
- 33-9. Rope drive

Examples XXXIII

### Chapter 34 Toothed Gearing
- 34-1. Introduction
- 34-2. Friction wheels
- 34-3. Toothed wheels: Definitions
- 34-4. Motion transmitted by toothed gearing
- 34-5. Forms of wheel teeth
- 34-6. Trains of wheels
- 34-7. Design of wheel trains
- 34-8. Wheel train for a 12-hour clock
- 34-9. Screw-cutting Lathe
- 34-10. Lathe back-gear for speed reduction
- 34-11. Three-speed gear-box of a motor car
- 34-12. Epicyclic gearing
- 34-13. Epicyclic trains with bevel wheels
- 34-14. Humphage's speed-reduction gear
- 34-15. The differential gear
- 34-16. Epicyclic gearing: alternate method

Examples XXXIV

### Chapter 35 Lifting Machines
- 35-1. Definitions
- 35-2. Basic machines
- 35-3. Differential wheel and axle
- 35-4. Differential pulley-block
- 35-5. Differential screw
- 35-6. Pulley-blocks
- 35-7. Lifting machines with toothed gearing
- 35-8. Worm gearing
- 35-9. Worm geared screw jack
- 35-10. Worm geared pulley block
- 35-11. Linear law of machines
- 35-12. Reversibility of a machine
- 35-13. Compound efficiency

Examples XXXV

### Chapter 36 Mechanical Vibrations
- 36-1. Introduction
- 36-2. Classification of vibrations
- 36-3. Vibration parameters
- 36-4. Free undamped vibrations of a particle: Spring-mass system
- 36-5. Composite springs
- 36-6. Simple pendulum
- 36-7. Conical pendulum
- 36-8. Compound pendulum

Examples XXXVI

### Chapter 37 Hydrostatics
- 37-1. Introductory: Fluids and liquids
- 37-2. Liquid pressure
- 37-3. Relation of pressure to depth in a liquid
- 37-4. Total thrust on a plane vertical area immersed in a liquid: Centre of Pressure
- 37-5. Total thrust on an inclined plane area immersed in a liquid
- 37-6. Floatation and Buoyancy
  - CONDITIONS OF EQUILIBRIUM OF A FLOATING BODY
- 37-7. Metacentre
- 37-8. Metacentric height

Examples XXXVII

### Chapter 38 Impact of Jets
- 38-1. Force exerted by a jet
- 38-2. Flat plates: Stationary as well as moving
- 38-3. Curved vanes
- 38-4. Pelton wheel: Turbines

Examples XXXVIII

### Appendix 1 Selected Mathematics

### Appendix 2 Objective Questions

INDEX