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978-1-107-49983-6 - Foundations and Applications of Engineering Mechanics

H. D. Ram and A. K. Chauhan

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Foundations and Applications of Engineering Mechanics

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Dedicated to Students

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Preface

Mechanics is the science which describes and predicts the motion of bodies under the application of forces. *Engineering mechanics* is the branch of engineering which applies the laws of mechanics in design, and is at the core of every machine designed. It is almost impossible to over-emphasize the importance of this subject in engineering. It is apparent that having a sound knowledge of the fundamental principles of engineering mechanics and the techniques of their application are very essential for one to be considered a good engineer.

This book covers course material for the Engineering Mechanics syllabus of most universities in India. This textbook has been designed for undergraduate students pursuing an engineering course. It is expected that the book will also be useful to students preparing for India Engineering Services (IES), GATE and other PSU examinations.

The special features of the book are

- Discussion on the limitations of the assumptions/idealizations
- The elastic spring model for finding deflection in the elastic systems
- Simple integration instead of double and triple integrals for finding moment of inertia
- Numerous examples to cover all the fundamental principles: the reader is expected to study them carefully
- Step-by-step problem-solving approach throughout the book
- Summary in each chapter for quick reference
- Concept Review Questions and Exercises aimed at strengthening the learnt methods for solving the problems
- Objective Questions, True/False and Fill in the Blanks questions modeled from the main text to reinforce the understanding of fundamentals.

The book is divided into twelve chapters. Chapter 1 titled Mechanics deals with the laws of mechanics, idealization of mechanics, and establishes the equations of equilibrium for a rigid body, free-body diagrams (FBD) and their applications. Chapter 2 deals with the laws of friction and its engineering applications. Shear force and bending moment are discussed in Chapter 3. In this chapter, the method of solving problems does not discriminate between various types of loading/supports. Analytical and numerical methods are discussed and explained with numerical examples which are a unique feature of the book. Analysis of plane truss and frame is presented in Chapter 4. It is clarified that the method of joints uses the FBD of the connecting pins. The concept of centroid and moment of inertia is discussed in Chapter 5. The importance of the concept of centroid in the stress analysis of beams, shafts and dynamics of rigid bodies is pointed out in this chapter. The kinematics of a particle is defined in Chapter 6. Kinematic analysis of particle and rigid body is presented in this chapter. Chapter 7 deals with kinetics of particle and

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rigid bodies. Impulse, momentum and energy methods are explained here. Simplest equivalents of inertia force and inertia couple are presented for different conditions of rigid bodies. Method of Virtual work is given in Chapter 8. Concept of virtual work, kinematically admissible displacements, degrees of freedom and conditions of equilibrium are described. Chapter 9 deals with mechanical vibration. Free and forced vibrations are explained in this chapter. Chapter 10 presents the analysis of simple stress in bars of different sections. Equivalent elastic spring model for solving problems has been introduced in this chapter. Bending stress and shear stress in beams are discussed in Chapter 11. Finally, torsion of circular shaft is discussed in Chapter 12.

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Finally, we extend our thanks to all our well wishers and friends for their encouragement and support.

List of abbreviations

FBD	Free body diagram
CCW	Counter Clockwise
CW	Clockwise
SFD	Shear Force Diagram
BMD	Bending Moment Diagram
PE	Potential Energy
KE	Kinetic Energy
ME	Mechanical Energy
ODE	Ordinary Differential Equation
CG	Center of Gravity
MI	Moment of Inertia