MECHANICS

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KEY SELLING POINTS

- Written by authors with a lifetime of physics teaching experience
- Adaptable to different levels of study

BOOK INFORMATION

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The study of mechanics is an integral part of all physics and engineering courses. But emphasis on the knowledge of mechanics differs widely from one university to the next.

The contents of this book have been selected and developed to provide a bridge between undergraduate and postgraduate courses. With numerous solved examples, reviewed problems and more elaborate objective questions, and with key chapters on fluid mechanics, analytical mechanics and non linear oscillations and chaos, “Mechanics” will prove to be an excellent textbook for upper level students of physics and engineering

Contents:

2. Non-Intertial Frames
   Non-inertial frames; Reference frame with translational acceleration and fictitious or pseudo or inertial force; Coriolis and centrifugal forces; Motion relative to the earth; Equation of motion and deviation of freely falling bodies on earth; Effect of coriolis force on nuclear and molecular motion; Satellite motion

3. Laws of Conservation
   Introduction; Law of conservation of mass; Conservation of energy; Work-energy theorem; Conservative forces; Potential energy; Rectilinear motion under conservative force; Non-conservative forces; Principle of conservation of momentum; Centre of mass (or centre of inertia); Collisions; Collision in centre of mass frame; Relations between scattering angles in Labs and CM frames; Kinetic energy collision; Systems with variable mass; Angular momentum (or moment of momentum); Angular momentum of a system of particles or an extended system; Angular momentum of two particles relative to their CM or C-Frame; Law of conservation of angular momentum; Angular momentum of the extended system about an arbitrary point; Rutherford Scattering: Scattering of charged particles by heavy nuclei.

4. Dynamics of Rigid Bodies
   Introduction; Moment of inertia; Theorem of moment of inertia; Calculation of moment of inertia; Energy of a rotating rigid body; Gyroscopes; Spin precession in constant magnetic field; Fly-wheel; Angular momentum in quantum mechanics; Molecular rotations.

5. Motion under Central Forces: The Universal Gravitation
   Introduction; Nature of central forces; Motion under central force; Newton's law of universal gravitation; Inertial and gravitational mass; Motion in gravitational field: Kepler's laws; Rutherford scattering; Gravitational field and potential; Three particles system; Inter-planetary flights; Binary stars; Gravitation and intermolecular forces

6. Elastic properties of Matter
   Introduction; Some definitions; Different types of co-efficients of elasticity; Theorems on stress and strain; Relations between elastic constants; Bending of beams; The cantilever-depression of its loaded end; Transverse vibration of a cantilever; Beam supported at both ends and loaded in the middle; torsion of a cylinder; Torsional oscillations; Determination of elastic constants; Origin of elastic forces; Determination of γ by bending: Determination of poisson's ratio of rubber.

7. Fluid Mechanics
   Introduction; Properties of fluids; Archimedes; principle; Euler's equation of motion for a moving fluid; Torricelli's theorem: Speed of efflux of a fluid from a large vessel; Irrotational continuous flow of inviscid fluids; The continuity equation; The Bernoulli's equation: Steady flow of fluids; Venturimeter; Laminar

and turbulent flows; Coefficient of viscosity; Limiting or terminal velocity; Reynold's number; Flow of a liquid in a round pipe: Poiseuille's formula; Lift.

8. Oscillatory Motion
   Introduction; Oscillations in a potential well; Simple harmonic motion (SHM); Some examples of free vibrations; Superposition of two simple harmonic motions; Superposition of mutually perpendicular two SHMs; Coupled oscillators; Anharmonic oscillations; Damped oscillations; Power dissipation in damping oscillations; Auto-oscillations; Forced oscillations; Fourier analysis of periodic motion.

9. Fundamentals of Analytical Mechanics
   Introduction; Generalized coordinates; Lagrangian-hamilton's variation principle; Hamiltonian formalism.

10. Non-Linear Oscillations and Chaos
    Introduction; Singular points of trajectories; Non-linear oscillations; Chaos; Logistic map; Fractals.

11. Relativistic Mechanics
    Introduction; Inertial frames of reference; Galilean transformations; Velocity of light; The search for the ether; Michelson-Morley experiment; Lorentz and Fitzgerald hypothesis; Einstein's special theory of relativity; Lorentz transformation; Proper frame, proper length and proper time; Experimental verification of time dilation; Relativistic velocity transformation equations; Relativity of mass; Mass-energy equivalence; Relation between momentum and energy; Particles with zero rest mass; Speed limit for material particles; Space and time in relativity; Four-vector notation; The velocity four vector; the momentum four-vector; The four-force vector; Electromagnetic interaction; The current density "Four-Vector"; The relativistic doppler effect