Mechanics and Thermodynamics

Course Code: BEB108 **Credit: 04 (L-3, T-1, P-0)**
Contact Hours: 60 **MM: 100**

Course Outline

Rotational dynamics and elasticity

System of particles, Center of mass, Equation of motion of the CM, Conservation of linear and angular momentum, Conservation of energy, Fixed axis rotations, Rotation and translation, Moments of Inertia, Parallel and perpendicular axes theorem, Relation between elastic constants, Bending of beams & torsion

Oscillation

SHM: Simple harmonic oscillations, differential equation of SHM and its solution, amplitude, frequency, time period and phase, velocity and acceleration. kinetic, potential and total energy and their time average values, free oscillations of systems with one degree of freedom: (i) mass-spring system, (ii) simple pendulum,(iii) torsional pendulum (iv) electrical oscillator (LC circuit)

Laws of Thermodynamics

Zeroth law of thermodynamics and concept of temperature, Work and heat energy, First law of thermodynamics, Differential form of first law, Internal energy, First law and explanation of various thermo-dynamical processes, Applications of first law: general relation between C_p and C_v, Work done during isothermal and adiabatic processes, Reversible and irreversible changes, Carnot cycle and its efficiency

Entropy

Concept of entropy, Change in entropy, Second law of thermodynamics in terms of entropy, Entropy of a perfect gas, Entropy of the universe, Entropy changes in reversible and irreversible processes, Calculations of change of entropy, Principle of increase of entropy

Thermodynamic potentials and Maxwell's relations

Thermodynamic variables, Thermodynamic potentials (U, H, F and G) and their definitions, properties and applications, Derivations of Maxwell's relations, Applications of Maxwell's relations: (i) Clausius-Clapeyron equation, (ii) Values of C_p - C_v (iii) TdS equations, (iv) Joule-Thomson coefficient for ideal and Vander-Waal gases, (v) Energy equations and (vi) Change of temperature during an adiabatic process

Suggested Reading:

- Daniel Kleppner, Robert J. Kolenkow, An introduction to mechanics, McGraw-Hill, 1973
- F W Sears, M W Zemansky and H D Young, University Physics, Narosa Publishing House, 1982
- David Halliday, Robert Resnick Jearl Walker Principles
- Mark Waldo Zemansky, Richard Dittman, Heat and Thermodynamics: An Intermediate Textbook, McGraw-Hill, 1981
- Francis W. Sears & Gerhard L. Salinger, Thermodynamics, Kinetic Theory, and Statistical Thermodynamics, Narosa, 1986
- Charles Kittel, Walter Knight, MalvinRuderman, Carl Helmholz, Burton Moyer,
- Mechanics Berkeley physics course, Vol.1: Tata McGraw-Hill, 2007
- Keith R. Symon, Mechanics, Addison Wesley; 3 edition, 1971
- D. S. Mathur, Mechanics, (S. Chand & Company Limited, 2000)
- Enrico Fermi, Thermodynamics, Courier Dover Publications, 1956
- MeghnadSaha, B. N. Srivastava, A Treatise on Heat: Including Kinetic Theory of Gases, Thermodynamics and Recent Advances in Statistical Thermodynamics Indian Press, 1958
- Garg, Bansal and Ghosh, Thermal Physics, Tata McGra-Hill, 1993

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