
Semester I

PHYSICS-DSC 1 A: MECHANICS (PCMP-311)

(Credits: Theory-04)

Theory: 64 Lectures

Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter. **(4 Lectures)**

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients. **(6 Lectures)**

Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. **(10 Lectures)**

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets. **(6 Lectures)**

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum. **(5 Lectures)**

Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS). **(8 Lectures)**

Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. **(6 Lectures)**

Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion - Torsional pendulum-Determination of Rigidity modulus and moment of inertia - q , η and σ by Searles method **(8 Lectures)**

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities. **(7 Lectures)**

Note: Students are not familiar with vector calculus. Hence all examples involve differentiation either in one dimension or with respect to the radial coordinate.

Reference Books:

- University Physics. FW Sears, MW Zemansky and HD Young 13/e, 1986. Addison-Wesley
 - Mechanics Berkeley Physics course, v.1: Charles Kittel, et. Al. 2007, Tata McGraw-Hill.
 - Physics – Resnick, Halliday & Walker 9/e, 2010, Wiley
 - Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
 - University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
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PHYSICS LAB: MECHANICS (PCMP-312)

(Credits: Practicals-02)

16 Lectures (4 hours each)

1. Use of Vernier callipers, Screw gauge, Spherometer, Barometer, Sphygmomanometer, Light meter, dry and wet thermometers, TDS/conductivity meter and other measuring instruments based on applications of the experiments. Use of Plumb line and Spirit level.
2. To study the random errors in observations.
3. Determination of height (of inaccessible structure) using sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine g and velocity for a freely falling body using Digital Timing Technique
7. To determine the value of g using Kater's Pendulum.
8. To study the variation of time period with distance between centre of suspension and centre of gravity for a bar pendulum and to determine:
 - (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length.
 - (ii) The value of g in the laboratory.
9. Determination of coefficient of viscosity of a given liquid by Stoke's method. Study its temperature dependence.
10. To determine the Young's modulus by bending of beam using a traveling microscope/laser.
11. Determination of modulus of rigidity by dynamic method Maxwell's needle.
12. To determine the elastic Constants of a wire by Searle's method.
13. To study one dimensional collision using two hanging spheres of different materials.

Reference Books:

- Advanced Practical Physics for students, B.L. Flint, and H.T. Worsnop, 1971, Asia Publishing House.
 - Advanced level Physics Practical, Michael Nelson, and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
 - Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
 - A Textbook of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
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