Course: Core Paper II - HPHCR1022T & HPHCR1022P

Semester	I
Paper Number	HPHCR1022T & HPHCR1022P
Paper Title	Mechanics
No. of Credits	06 (Theory – 4, Lab – 2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 periods/week Pr: 3 periods/week
Name of Faculty member(s)	
Course description/objective	This course aims to provide a basic idea on classical Mechanics and its application for the undergraduate students
Syllabus	As enclosed
Texts	As enclosed
Reading/Reference Lists	As enclosed
Evaluation	Total – 100 (Theory – 60, Practical – 40) Theory – CIA – 10 Semester Examination – 50 Group A (25 marks) Group B (25 marks) One 10 marks qs out of two qs One 10 mark qs out of two qs Three 5 mark qs out of five qs Three 5 mark qs out of five qs

Syllabus :

HPHCR1022 T - MECHANICS (Credits: Theory-04, Practicals-02)

Module A [26 lectures]

Fundamentals of Dynamics: Reference frames. Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. Momentum of variable mass system: motion of rocket. Motion of a projectile in Uniform gravitational field Dynamics of a system of particles. Centre of Mass. Principle of conservation of momentum. Impulse. **[6 Lectures]**

Work and Energy: Work and Kinetic Energy Theorem. Conservative and non-conservative forces. Potential Energy. Energy diagram. Stable and unstable equilibrium. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non-conservative forces. Law of conservation of Energy. **[3 Lectures]**

Collisions: Elastic and inelastic collisions between particles. Centre of Mass and Laboratory frames. **[3 Lectures]**

Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame. Laws of Physics in rotating coordinate systems. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cylindrical and Spherical Coordinate Systems. **[4 Lectures]**

Rotational Dynamics: Angular momentum of a particle and system of particles. Torque. Principle of conservation of angular momentum. Rotation about a fixed axis. Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation.

[10 Lectures]

Module B [26 lectures]

Elasticity: Relation between Elastic constants. Twisting torque on a Cylinder or Wire. [**3 Lectures]**

Fluid Motion: Kinematics of Moving Fluids: Poiseuille's Equation for Flow of a Liquid through a Capillary Tube.

[**2 Lectures]**

Gravitation and Central Force Motion: Law of gravitation. Gravitational potential energy. Inertial and gravitational mass. Potential and field due to spherical shell and solid sphere. **[2 Lectures]**
Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's Laws. Satellite in circular orbit and applications.
[4 Lectures]

Oscillations: SHM: Simple Harmonic Oscillations. Differential equation of SHM and its solution. Damped oscillation. Forced oscillations: Transient and steady states; Resonance, sharpness of resonance; power dissipation and Quality Factor. **[5 Lectures]**

Special Theory of Relativity: Michelson-Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformation equations (Derivation not required). Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, frequency and wave number. Relativistic addition of velocities. Variation of mass with velocity (no derivation). Massless Particles. Mass-energy Equivalence. Relativistic Doppler effect. Relativistic Kinematics. **[10 Lectures]**

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
3. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
4. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
5. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
6. Advanced Acoustics, D.P. Roy Chaudhuri
7. Introduction to Classical Mechanics, R.G. Takwale & P.S. Puranik
8. Classical Mechanics & General Properties of Matter, S.N. Maiti & D.P. RoyChaudhuri
9. Classical Mechanics, H. Goldstein, Narosa Publication.
10. Classical Mechanics , John R. Taylor, University Science Books
11. Classical Mechanics, N.C. Rana & P.S. Joag, Tata McGraw-Hill Education Pvt. Ltd.

HPHCR1022P – Mechanics Lab – (Credits – 2) (39 periods)

1. Measurements of length (or diameter) using vernier calliper, screw gauge and travelling microscope.

2. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

5. To determine **g** and velocity for a freely falling body using Digital Timing Technique

6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).

7. To determine the Young's Modulus by Flexure method.

8. To determine the value of g using Kater's Pendulum.

Reference Books

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal
4. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Advanced Practical Physics, Vol. 1 and 2, B. Ghosh & K.G. Mazumder, Sreedhar Publishers