

Course: Generic Elective I - HPHGE1012T & HPHGE1012P

Semester	I
Paper Number	HPHGE1012T & HPHGE1012P
Paper Title	Mathematical Methods, Mechanics , General Properties of Matter & Thermal Physics
No. of Credits	06 (Theory – 4, Lab – 2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 periods/week Pr: 2 periods/week
Name of Faculty member(s)	
Course description/objective	The objective of this module of generic elective physics paper aims to give the students a basic idea on mathematical physics, mechanics and general properties of matter. Some of the topics covered in this course have applications in areas relevant for students pursuing their studies in other areas of basic sciences. We expect that after attending this course, the students will acquire sufficient analytical knowledge to apply these concepts in their own areas of interest.
Syllabus	As enclosed
Texts	
Reading/Reference Lists	As enclosed
Evaluation	Total – 100 marks (Theory – 60, Practical- 40) Theory – CIA- 10 Semester Examination – 50 Group A : (25 marks) Two 5 marks qs out of three qs Six 2.5 mark qs out of eight qs Group B (25 marks) Two 5 mark qs out of three qs Six 2.5 mark qs out of eight qs

Syllabus

Mathematical Methods, Mechanics, General Properties of Matter & Thermal Physics (Credits – Theory -4; Practical – 2)

Module A: Mathematical Methods, Mechanics & General Properties of Matter [26 lectures]

Mathematical Methods: Scalar and vector fields, gradient, divergence and curl. Statements of Stokes' & divergence theorem, polar coordinates, spherical polar coordinates, line, surface and volume element. [6L]

Mechanics : Systems of particles, centre of mass, line and time integral of forces, central forces: definition and properties, reduced mass (equivalent one body problem), types of orbits under central forces (qualitative), conservative force field concept of potential, conservation principles. Rotational kinematics and dynamics – Rigid body motion , kinetic energy of a rotating body, conservation of angular momentum. Moment of inertia – physical significance, radius of gyration, parallel and perpendicular axis theorem (applications: rectangular bar, annular disc, sphere, cylinder). [12L]

General Properties of Matter : Torsion of a cylinder, bending moment equation, bending of beam supported at ends with a concentrated load at the centre. Surface tension, surface energy, angle of contact, capillary phenomena. Newton's law of viscous force, Poiseuille's equation, Bernoulli's theorem and applications. [8L]

Module B: Thermal Physics [26 lectures]

Kinetic theory of gases : Introduction, Law of atmosphere, Maxwell's law of velocity distribution, most probable velocity, r.m.s. speed and mean speed. Degrees of freedom, equipartition of energy, characteristics of Brownian motion, Equation of State of real gases :Van der Waal's equation. [8L]

Thermodynamics : Introduction, first law of thermodynamics and its applications, reversible and irreversible processes, cyclic process. Work done by a perfect gas during isothermal and adiabatic process, Second law of thermodynamics – Clausius and Kelvin statements and their equivalence, Carnot's theorem, entropy and disorder. [12L]

Radiation : Introduction, Planck's law of blackbody radiation, Wien's displacement law, Rayleigh-Jean's law, Stefan's law. [6L]

References :

- (1) Handbook of Degree Physics, C.R. Dasgupta
- (2) General Properties of Matter, Maiti & D. P. RayChowdhury
- (3) Vector Analysis, M. Spiegel and S. Lipschutz
- (4) Heat & Thermodynamics, Zemansky & Dittman

Mathematical Methods, Mechanics, General Properties of Matter & Thermal Physics Lab
(Credits – 2) [26 Periods]

1. Determination of the Young's modulus of the material of the given uniform bar supported at two ends and loaded at the centre.
2. Determination of the modulus of rigidity of the material of a given wire by dynamical method.
3. Determination of the moment of inertia of a cylinder about an axis passing through its centre of gravity and perpendicular to its length using a cylinder as an auxiliary body and comparison of the moment of inertia thus obtained with the theoretical value calculated with the measured mass and dimensions of the bar.
4. Determination of the surface tension of water by capillary rise method
5. Determination of the coefficient of viscosity of water by Poiseuille's method.
6. Determination of temperature coefficient of resistance of the material of a coil by Carey-Foster bridge.
7. Verification of Stefan's law

References :

1. A textbook on Practical Physics, K.G. Mazumdar & B. Ghosh, Sreedhar Publishers
2. Advanced Practical Physics Vol 1. B. Ghosh & K.G. Mazumdar, Sreedhar Publishers
3. Advanced Practical Physics Vol 2. B. Ghosh, Sreedhar Publishers
4. An Advanced Course in Practical Physics, D. Chattopadhyay, P.C. Rakshit, New Central Book Agency Pvt. Ltd.