Syllabus for Engineering Physics

(For B.Tech students of Engineering disciplines)

Semester I: PHYUGBS01: Engineering Physics

Credits: Th+Pr+Tu = 3+0+0 **60 Lectures**

Course objectives

This subject is common to all first year branches of UG engineering. The main objective of this course is to familiarize students with the basic principles of physics which are the foundation stone of various engineering course. This will intern equip the engineering undergraduates with an understanding of the scientific method, so that they may use the training beneficially in their higher pursuits. To be specific, students will be able to

- Understand the concepts of classical mechanics and its application in various properties of matter namely in fluid dynamics, elasticity etc.
- Understand the fundamental theories of heat and thermodynamics.
- Understand the basic principles of physical optics and an introductory idea of quantum optics.
- Understand the fundamental theories of electricity, magnetism and their application in circuit theories.
- Understand the fundamentals of solid state physics namely the crystallography, band theory, electric and magnetic property and an introductory idea of superconductivity.
- Understand the elements of modern physics, specially the key features of quantum world at the subatomic levels.

Course outcomes

The knowledge of the fundamental principles of Physics relevant to engineering is extremely important for converting ideas into technology. An understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements. In the present course, the students can gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the electromagnetic waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fibre Optics, properties of the materials in solid phase and the interesting aspects of the quantum systems. Various chapters of this course will therefore establish a strong foundation to realise various technical and engineering applications.

Course contents

Mechanics — 10 Lectures

Scalars and vectors, vector multiplication, central force, mechanics of system of particles, rotational motion, elastic properties, fluid dynamics: viscosity, Stoke's law, streamline flow, equation of continuity, Reynold's number, Bernoulli's theorem

Heat & Thermodynamics — 15 Lectures

Basic assumptions of kinetic theory, Ideal gas approximation, deduction of perfect gas laws. Interpretation of temperature. Maxwell's distribution law, r.m.s, mean and most probable velocity, collision probability, distribution of free path and mean free paths from Maxwell's distribution, principle of equipartition of energy. Thermodynamic variables of a system, state function, exact and inexact differentials. Isolated system, closed system, open system, extensive and intensive properties. Thermal equilibrium, Zeroth law and the concept of temperature; Thermodynamic equilibrium, internal energy, external work, 1st law of thermodynamics and it's simple applications, Reversible and irreversible processes, second law of thermodynamics, Carnot-cycle, and it's efficiency, Carnot's theorem.

Optics — 15 Lectures

Huygen's principle, Interference of light, Young's double-slit experiment, Newton's ring; Diffraction: Fresnel and Fraunhofer class, Fresnel's half-period zones, zone plate, Fraunhofer diffraction due to single slit and plane transmission grating (elementary theory); Polarization: plane, circular and elliptically polarized light, Brewster's law, Polaroid, optical activity. Coherence length and time; Einstein's A and B coefficients; spontaneous and induced emissions, condition for laser action, population inversion, He-Ne laser

Electrostatics and Electricity — 10 Lectures

Coulomb's law, intensity and potential of point charge, Gauss's theorem and simple applications, electric-dipole, Electric displacement, capacitor, parallel plates and cylindrical, Thermoelectricity, Magnetic effects of currents, Self-inductance, Mutual inductance, Transformer Electric circuit elements and AC, DC circuit analysis.

Solid State Physics — 10 Lectures

Crystalline nature of solid, diffraction of X-ray, Bragg's law, Mosley's law, explanation from Bohr's theory, Origin of the energy gap, band theory; metal, semiconductor and insulators; intrinsic and extrinsic semiconductors, dia, para and ferro magnetic materials, superconductivity

Modern Physics **15 Lectures**

Photoelectric effect, de-Broglie's hypothesis, matter wave, Heisenberg's uncertainty principle, wave function, Schrodinger equation and simple problems. Mass and size of atomic nucleus, isotope., isotone, isobar, Binding energy of nucleus, Binding energy curve and stability, Radioactivity, successive disintegration, radioactive equilibrium, radioactive dating, radioisotope and their uses, Nuclear transmutation, fission & fusion, nuclear reactor, cyclotron.

Reference Books

- University Physics. F.W. Sears, M.W. Zemansky and H.D. Young, 13/e, 1986. Addison-Wesley
- Engineering Mechanics, Basudeb Bhattacharya, 2nd edn., 2015, Oxford University Press
- Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
- Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.
- A Treatise on Heat, Meghnad Saha, and B.N. Sriiastaia, 1969, Indian Press.
- Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. chand Publications
- Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
- Modern Physics, G. Kaur and G.R. Pickrell, 2014, McGraw Hill
- Principles of Optics, B.K. Mathur, 1995, Gopal Printing
- Fundamentals of Optics, H.R. Gulati and D.R. Khanna, 1991, R. Chand Publications
- Elements of Solid State Physics, J.P. Srivastaia, 2nd d., 2006, Prentice-Hall of India
- Solid State Physics, Rita John, 2014, McGraw Hill
- Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
- Solid State Physics, M.A. Wahab, 2011, Narosa Publications

Semester I: PHYUGBS02: Engineering Physics Lab

Credits: Th+Pr+Tu = 0+1.5+0 **60 Class hours**

Course objectives

This subject is common to all first year branches of UG engineering. At the end of the course the student is expected to draw the relevance between the theoretical knowledge and to imply it in a practical manner. To be specific, students will be able to

- Precisely measure the length of a linear object, the radius of curvature of a spherical surface, moment of inertia of different geometrical object etc.
- Determine the focal length of a different lenses

- Determine the horizontal component of the earth's magnetic field
- Analyse various electrical circuits and its components.
- Determine unknown frequency of a tuning fork.
- Determine elastic modulus of different materials.

Course outcomes

The student will learn to draw the relevance between theoretical knowledge and the means to imply it in a practical manner *i.e.* through hands on experience by performing various experiments. The student will be enabled to determine various physical e.g. elastic, optical, electric, magnetic properties of the different systems along with precise measuremental techniques and to quantify the relative errors of those experiments.

List of experiments

- Measurements of length (or diameter) using Vernier scale, slide callipers, screw gauge and travelling microscope.
- Determination of the radius of curvature of a spherical surface by using spherometer.
- Determination of moment of inertia of (a) a cylinder and (b) a rectangular solid bar.
- To determine the focal length of a concave lens by combination method and hence to determine the refractive index of the material of the lens by measuring the radii of curvature of both lenses
- Determination of the average resistance per unit length of the meter bridge wire by Carey-Foster's method and hence to determine an unknown resistance
- Determination of the horizontal component of the earth's magnetic field and the magnetic moment of a magnet by employing magnetometers
- Determination of Young's Modulus of elasticity of a material of a bar by the method of flexure.
- Determination of rigidity modulus of a material of a wire by static method.
- Determination of rigidity modulus of a material of a wire by dynamic method.
- Determination of unknown frequency of a tuning fork by using a sonometer.

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th edition, reprinted 1985, Heinemann educational Publishers
- A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th dn., 2011, Kitab Mahal