# Department of Physics

## Course Outcomes for 3 Year B.Sc. General Course in Physics under Choice Based Credit System (CBCS)

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# Course Outcomes for Core Courses

## Mechanics (PHSGCOR01T and PHSGCOR01P)

**Course description**

The objective of this freshmen level course is to give students idea about the mechanics of point particle and general properties of matter. The course includes a module on mathematical physics where basics of vector calculus and ordinary differential equation are taught to build the necessary mathematical foundation.

**Course Outcomes**

**CO1 :** Comprehend basic vector calculus – products, derivatives and integration of vectorial quantities. Learn how to solve first order and second order homogeneous and inhomogeneous ordinary differential equations.

**CO2 :** Understand Newtonian mechanics and frames of reference. Understand the conservation laws in motion of a point particle or system of particles. Understand rotational motion - angular velocity and angular momentum, torque, conservation of angular momentum.

**CO3 :** Learn Newtonian theory of gravitation, Kepler's laws. Acquire basic idea of statellites in circular orbits and GPS.

**CO4 :** Understand simple harmonic motion and the properties of systems executing such motions.

**CO5 :** Acquire knowledge about elasticity – Hooke's law, relation between elastic constants, Poisson's ratio, work done in stretching and work done in twisting a wire - bending of beam.

**CO6 :** Acquire basic idea of special theory of relativity and relativistic effects on the motion of an object.

**CO7 :** Acquire hands on training experience to verify concepts learned in the theory.

## Electricity and Magnetism (PHSGCOR02T and PHSGCOR02P)

**Course description**

This is a foundation course on electricity and magnetism to introduce to the students basic ideas of classical notion of electric and magnetic fields, fundamental equations governing the behavior of electromagnetism, electric circuits and network analysis.

**Course Outcomes**

**CO1 :** Understanding of gradient, divergence and curl, Gauss's theorem and Stokes theorem.

**CO2 :** Understanding of the electricity and magnetism in vacuum. Familiarity with the fundamental equations of electromagnetic theory for static electric configuration and steady current flows.

**CO3 :** Understand of the statistical nature of electricity and magnetism in matter, linear response of material bodies to external fields.

**CO4 :** Understand electromagnetic induction, Faraday's law, Lenz's law, self and mutual inductance.

**CO5 :** Understand linear networks, Thevenin and Norton theorems, Maximum power transfer and superposition theorem.

**CO6 :** Comprehend unified nature of electromagnetic phenomena embodied in the set of Maxwell's equations, displacement current, Poynting vector and conservaton laws in electromagnetic filed.

**CO7 :** Acquire hands-on experience about the electric circuits in the laboratory.

## Thermal Physics and Statistical Mechanics
## (PHSGCOR03T, PHSGCOR03P)

**Course Description :** Thermal Physics and Statistical Physics core is an introductory course to give inculcate among the students an understanding of the kinetic theory of gases, basic laws of thermodynamics, thermodynamic potentials. The students will learn about the classical statistical mechanics, the theory of blackbody radiation and three different statistical distributions (Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac).

**Course Outcomes**

On successful completion of this core course students will

**CO1 :** Understand the zeroth, first and second laws of thermodynamics, the nature of thermodynamic properties of matter like internal energy, entropy, specific heats, temperature. Understand reversible and irreversible process, conversion between heat and work, Carnots's Theorem.

**CO2 :** Understand thermodynamic potentials, Free energy, Maxwell's relations, Clausius Clapeyron equation.

**CO3 :** Acquire knowledge in the kinetic theory of gases, velocity distribution laws, molecular collisions, the process of thermal conductivity, viscosity and diffusion in gases.

**CO4 :** Acquire knowledge on the blackbody radiation, different laws relating to radiation, Planck's Law. Understand identical particles and indistinguishability, derivation of Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics and their applications in different physical systems.

**CO5 :** Verify concepts learned in theoretical course through hands on experiments in the laboratory.

## Waves and Optics (PHSGCOR04T and PHSGCOR04P)

**Course description**

This aim freshmen course is to develop an understanding of wave motion in material media and its properties, principles of optics and optical instruments.

**Course outcomes**

**CO1 :** Understand mathematical structure of oscillator equation and superposition principle.

**CO2 :** Understand wave equation and its solutions, superposition of waves, normal modes of a string, group velocity and phase velocity.

**CO3 :** Acquire basic knowledge about fluid motion, surface tension and shear viscosity.

**CO4 :** Understand propagation of sound waves, characteristics of sound, acoustics.

**CO5 :** Understand optics as phenomena involving electromagnetic waves. Understand polarization, interference and diffraction of light. Comprehend the working of optical instruments like biprism, interferometer, diffraction grating.

**CO6 :** Gain hands on experience in the laboratory to study interference or diffraction of waves.

# Course Outcomes for Department Specific Elective Courses

## Digital, Analog Circuits and Instrumentation (PHSGDSE01T and PHSGDSE01P)

**Course Description:**

Digital, Analog Circuits and Instrumentation course encompasses analog and digital electronic circuits to understand the number representation and conversion between different representation in digital electronic circuits. The objective of this course is to provide informations with sufficient fundamental theoretical and practical knowledge to pursue advanced topics in analog and digital integrated circuits.

**Course outcomes**

**CO1 :** Understand Analog and Digital Circuits, Binary Numbers and conversion to Decimal, different Logic gates and related theorems.

**CO2 :** Understand semiconductor diodes. Gather ideas on different amplifiers using transistors.

**CO3 :** Understand the design of Op-Amp, its characteristics and applications in various aspects. Understand Sinusoidal Oscillators, Barkhausen's Criterion.

**CO4 :** Learn about CRO and its applications. Gather Idea of Rectifiers and method for calculation of Ripple Factor.

## Perspectives of Modern Physics (PHSGDSE02T and PHSGDSE02P)

**Course description**

Elements of Modern Physics is an introductory course to give students an understanding of relativistic dynamics, quantum theory of light, wave function description, wave particle duality, atomic and nuclear Physics.

**Course Outcomes**

On successful completion of this core course students will :

**CO1 :** Acquire knowledge on Lorentz transformation, velocity addition; **know** the concept of relativistic mass, and momentum, two body elastic collisions.

**CO2 :** Understand limitations of classical theory of electromagnetic radiation, Planck's law of black body radiation, Photoelectric effect, Compton's scattering, Rutherford's model of atomic structure. Bohr's model

**CO3 :** Acquire knowledge on De Broglie's hypothesis Wave particle duality, Davisson-Germer experiment, Bohr's quantization postulate for stationary orbits, Heisenberg Uncertainty principles.

**CO4 :** Acquire knowledge on wave functions, linear superposition principle of wave functions, Schrödinger equation for non-relativistic particles, momentum and energy operators, stationary states, probability and probability current densities in one dimension.

**CO5 :** Understand application of Schrödinger equation in one dimensional infinitely rigid box and a rectangular potential barrier, energy eigenvalues and eigenfunctions, quantum dot, quantum mechanical scattering and tunneling across a step potential and across a potential barrier.

**CO6 :** Understand energy and orbital angular momentum of hydrogen and hydrogen like atoms, space quantization, orbital magnetic moment, spin Magnetic moment, Zeeman effect, Larmour Precession, spin-orbit interaction and fine-structure splitting Pauli's Exclusion Principle and Aufbau principle

**CO7 :** Understand structure of atomic nucleus, nuclear force, binding energy curve, mass formula, radioactivity, alpha and beta decay, gamma ray emission, nuclear Fission and fusion, nuclear reactor.

**CO8 :** Develop elementary concept of Bohr's model of atomic structure and generation of X-ray, Mosley's law, amorphous and crystalline solids, concept of Lattice, unit cell and basis vectors, diffraction of X-ray by crystalline solid and Bragg's law.

## Solid State Physics (PHSGDSE03T and PHSGDSE03P)

**Course description**

The objective of this course is to enable the students to have a physical understanding of matter from an atomic or microscopic point of view. This course contains the basic of atomic arrangement inside the material, lattice dynamics, band theory of solids, magnetic and dielectric properties of matter and super conductivity.

**Course Outcomes**

On successful completion of the course the students will learn about

**CO1 :** Amorphous and Crystalline Materials, Concept of Lattice, Miller Indices, Reciprocal Lattice, Brillouin Zones, Diffraction of X-rays by Crystals, Atomic and Geometrical Factor.

**CO2 :** Lattice Vibrations and Phonons, Acoustical and Optical Phonons, Dulong and Petit's Law, Einstein's theories of specific heat of solids, Debye correction, $T^3$ law.

**CO3 :** Magnetic Materials, Classical Langevin Theory, Curie's law, Weiss's Theory of Ferromagnetism and Ferromagnetic Domains, Hysteresis and energy Loss.

**CO4 :** Polarization, Local electric Field, Dielectric Susceptibility, Polarizability, Clausius Mosotti equation, Dispersion and Cauchy relations, Langevin-Debye equation and Optical Phenomena.

**CO6 :** Drude's theory for free electron gas in metals, effective mass,

**CO7 :** Kronig Penny model, Band Gap, Conductors, Semiconductors and insulators, drift current, mobility and conductivity, Hall effect in metals.

**CO8 :** Superconductivity, Critical Temperature, Critical magnetic field, Meissner effect, Type I and type II Superconductors.

**CO9 :** Hands on experiments what they have learnt during this course like Coupling Coefficient of a Piezoelectric crystal, Hall coefficient of a semiconductor sample, Magnetic susceptibility of Solids, refractive index of a dielectric layer using SPR and others.

## Nuclear and Particle Physics (PHSGDSE04T and PHSGDSE04P)

**Course description**

The aim of this course is to inculcate among students a through understanding of nuclear physics and a cursory view of particle physics.

**Course outcomes**

**CO1 :** Learn the ground state properties of a nucleus, nuclear constituents.

**CO2 :** Understand the models of nucleus – liquid drop model, Fermi gas model, shell model and their applications in explaining nuclear properties.

**CO3 :** Understand nuclear decay, alpha, beta and gamma emission. Comprehend Gammow's theory of alpha decay, Geiger Nuttal law. Learn about beta and gamma emission kinematics.

**CO4 :** Understand nuclear reactions, their types, conservation laws, kinematics, Q value, cross section. Understand compound and direct reaction, Coulomb scattering.

**CO5 :** Acquire knowledge about of the interaction of Nuclear Radiation with matter, Bethe-Bloch formula, Cerenkov emission, photoelectric effect, Compton effect, neutron interaction with matter.

**CO6 :** Acquire basic idea about different types of nuclear detectors.

**CO7 :** Acquire basic idea about different types of particle accelerators.

**CO8 :** Understand different types particle interaction, symmetries and conservation laws governing particle interactions. Acquire basic idea of quark model and color confinement.

# Course Outcomes for SEC Courses

## Basic Instrument Skills (PHSSECO01M)

**Course Description :** The objective of this course is to provide the students with the basic ideas of measuring instruments (both theory and practical).

**Course Outcomes**

**CO1 :** Develop fundamental skill to handle basic measuring instruments.

**CO2 :** Learn about electronic voltmeter and will be able to use it efficiently.

**CO3 :** Understand about CRO and its efficient use.

**CO4 :** Acquire knowledge about signal generators, impedance bridge and Q-meter.

**CO5 :** Develop knowledge about digital instruments and will be able to handle digital meters.

## Computational Physics Skills (PHSSECO02M)

**Course Description**

The objective of this course is to give students an exposure to the use of computational resources as problem solving tool.

**Course Outcomes**

**CO1 :** Understand the importance of computer as problem solving tool in science. Acquire working knowledge of Linux operating system.

**CO2 :** Understand programming logic. Learn basics of Fortran 90/95 and exercise some simple programs.

C03 : Learn basics of LaTeX and Gnuplot and practice some simple examples.