Department of Physics
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COURSE OUTCOMES

BSC-I
OBJECTIVES OF THE COURSE

The undergraduate training in Physics is aimed at providing the necessary inputs so as to set forth the task of bringing about new and innovative ideas/concepts so that the formulated model curricula in physics becomes in tune with the changing scenario and incorporate new and rapid advancements and multi-disciplinary skills, societal relevance, global interface, self-sustaining and supportive learning. It is desired that under graduate i.e. B.Sc. level besides grasping the basic concepts of physics should in addition have broader vision. Therefore, they should be exposed to societal interface of physics and role of physics in the development of technologies.

BSC-I
PAPER - I
MECHANICS, OSCILLATIONS AND PROPERTIES OF MATTER
(paper code - 3563)

Course learning outcome:

After successful completion of the course, the student is expected to

CO1: Understand the motion of objects in different frame of references.

CO2. Learned conservation laws of energy and linear and angular momentum and apply them to solve problems.

CO3: Understand laws of motion, reference frames, and its applications i.e. projectile motion, simple harmonic oscillator, Rocket motion, elastic and inelastic collisions.

CO4: Learn basics of the kinematics and dynamics linear and rotational motion..

C05: Understand the phenomena of collisions and idea about center of mass and laboratory frames and their correlation.

CO6: Understand the application of central force to the stability of circular orbits, Kepler's laws of planetary motion.

CO7: Understand the dynamics of rotating objects i.e. rigid bodies, angular velocity, the moment of inertia, parallel axis theorem, the inertia tensor, the motion of rigid bodies. Non-inertial frames: pseudo forces, examples involving the centrifugal force and coriolis force.

CO8: Learn the fundamentals of harmonic oscillator model, including damped and forced oscillators and grasp the significance of terms like quality factor and damping coefficient.

CO9: Learn the basics of properties of matter, how Young's modulus and rigidity modulus are defines and how they are evaluated for different shapes of practical relevance.

CO10: Understand the basics of motion of fluid which includes streamlined and turbulent flows, equation of continuity, critical velocity, flow of a liquid through a capillary tube, capillaries in series and parallel, Stokes' formula.

CO11: Learn the concepts of elastic in constant of solids and viscosity of fluids.

ELECTRICITY, MAGNETISM AND ELECTROMAGNETIC THEORY
(paper code -3564)

Course learning outcome:
After successful completion of the course, the student is expected to:

CO1: Understand basics of vector calculus and Introduction to mathematical methods physicists often use, including operator ∇, divergence, gradient, curl and their physical interpretation, Green's theorem, Stokes' theorem and appreciate its applications.

CO2: Acquire knowledge of methods to solve partial differential equations with the examples of important partial differential equations in Physics.

C01: This course will help in understanding basic concepts of electricity and magnetism and their applications.

C03: Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.

C04: To realize the importance of application of Biot Savarts Law and Amperes law.

C05: Understand the dielectric properties, magnetic properties of materials and the phenomena of electromagnetic induction.

C06: Understand the Kirchhoff's rules to analyze AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.

C07: Apply various network theorems such as Superposition, Thevenin, Norton, Reciprocity, Maximum Power Transfer, etc. and their applications in electronics, electrical circuit analysis, and electrical machines.

C08: study in depth the transient current response of CR, LC, CR and LCR circuits, which is essential in designing as well as understanding the working of electronic circuits.

C09: student Should be able to solve a variety of problems related to Faraday's law of induction and Maxwell's equations.

C010: student Should be able to verify of various circuit laws, network theorems elaborated above, using simple electric circuits.

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LAB Course Outcomes
PHYSICS LAB
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LAB COURSE Physics

In the laboratory course, the student shall perform experiments related to mechanics (compound pendulum), rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method) etc.

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LAB COURSE Physics
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In the laboratory course the student will get an opportunity to verify various laws in Electricity and magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments.

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SEMINAR & GROUP DISCUSSION
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CO1: Understands advance problem based on topics related to paper-I and paper-II
CO2: The ability to communicate their ideas effectively, both orally and in writing.
CO3: Understands function effectively in multidisciplinary teams and topics.

Objectives:
Present course is aimed to provide ample knowledge of basics of physics which are relevant to the understanding of modern trends in higher physics. The first paper is aimed at preparing the background of thermodynamics and statistical physics essential for any advanced study of physics of condensed matter and radiations. The second paper is mainly concerned with a course on geometrical and Physical optics and the laser Physics. It deals with important phenomenon like inter-ference, diffraction and polarisation with stress on the basic nature of light. It also introduces the basics of laser physics with some of its important applications. The experiments are based mostly on the contents of the theory papers so as to provide Comprehensive insight of the subject.

**PAPER - I
THERMODYNAMICS, KINETIC THEORY AND STATISTICAL PHYSICS
(Paper Code -3663)**

Course learning outcome:
After successful completion of the course, the student is expected to

C01: In this course the students should skilled in doing calculations in thermodynamics, to understand various thermo dynamical concepts, principles and same as in statistical mechanics.

C02: Become familiar with various thermodynamic process and work done in each of this process. Students have a clear understanding about Reversible and irreversible process and also working of a Carnot engine, and knowledge of calculating change in entropy for various process.

C03: Learn the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also to learn Maxwell's thermodynamic relations.

C04: student Realize the importance of Thermo dynamical functions and applications of Maxwell's relations.

C05: student Learn about the real gas equations, Van der Waal equation of state, the Joule-Thompson effect.

C06: Learn to derive classical radiation laws of black body radiation. Wiens law, Rayleigh Jeans law, ultraviolet catastrophe. Saha Ionization formula.

C07: Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzman distribution law, equitation of energies, and mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.

C08: Understand the concepts of microstate, macrostate, ensemble, phase space, thermodynamic probability and partition function.

C09: Familiarize in depth about statistical distribution and have basic Ideas about Maxwell Boltzmann, Bose-Einstein and Fermi Dirac Statistics and their applications

C09: Understand the combinatoric studies of particles with their distinguishably or indistinguishably nature and conditions which lead to the three different distribution laws e.g. Maxwell-Boltzmann distribution, Bose-Einstein distribution and Fermi-Dirac distribution laws of particles and their derivation.

C010: Learn to calculate the macroscopic properties of degenerate photon gas using BE distribution law, understand Bose-Einstein condensation law and liquid Helium. Bose derivation of Plank's law

C011: Understand the concept of Fermi energy and Fermi level, calculate the macroscopic properties of completely and strongly degenerate Fermi gas, electronic contribution to specific heat of metals.

C012: Understand the application of F-D statistical distribution law to derive thermodynamic functions of a degenerate Fermi gas, electron gas in metals and their properties.

PAPER - II
WAVES, ACOUSTICS AND OPTICS
(Paper Code -3664)

Course learning outcome:
This course will enable the student to

C01: This course in basics of optics will enable the student to understand various optical phenomena, principles, workings and applications optical instruments.

C02: Study the general equation of wave motion in general and TM waves in stretched strings and longitudinal waves in gases

C03: Apply basic knowledge of principles and theories about the behaviour of light and the physical environment to conduct experiments.

C04: Understand the principle of superposition of waves, so thus describe the formation of standing waves.

C05: Explain several phenomena we can observe in everyday life that can be explained as wave phenomena.

CO6: Able to calculate what happens when waves move from one medium to another, and be able to explain dispersion and group and phase velocity. Use Lissajous figures to understand simple harmonic vibrations of same frequency and different frequencies.

CO7: Understand application of acoustics in noise and music, musical scale, sonar and ultrasonic.

CO8: Use the principles of wave motion and superposition to explain the Physics of polarisation, interference and diffraction.

CO9: Understand the working of selected optical instruments like biprism, interferometer, diffraction grating, and holograms.

CO10: Understand the resolving power of different optical instruments.

CO11: Understand working of optical fiber and their applications in communication

CO12: Qualitative understanding of basic lasing mechanism, types of Lasers, characteristics of Laser Light, types of Lasers, and its applications in developing LED, Holography.

CO13: The idea of propagation of electromagnetic wave in a nonlinear media – Fibre optics as an example will enable the student to practice thinking in a logical process, which is essential in science.

LAB COURSE Physics

In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings experiment, Fresnel Biprism etc. Resolving power of optical equipment can be learnt firsthand. The motion of coupled oscillators, study of Lissajous figures and behaviour of
transverse, longitudinal waves can be learnt in this laboratory course.

LAB COURSE Physics

In the laboratory course, the students are expected to do some basic experiments in thermal Physics, viz., determinations of Stefan's constant, coefficient of thermal conductivity, temperature coefficient of resistant, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple.

SEMINAR & GROUP DISCUSSION

CO1: Understands advance problem based on topics related to paper-I and paper-II
CO2: The ability to communicate their ideas effectively, both orally and in writing.
CO3: Understands function effectively in multidisciplinary teams and topics.

Objectives:
Present course is aimed to provide ample knowledge of basics of Physics which are relevant to the understanding of modern trends in higher physics.

The first paper is aimed at preparing the back ground of modern physics which includes the relativistic and quantum ideas mainly concerned with atomic, molecular and nuclear physics. It constitutes an essential pre-requisite for better understanding of any branch of physics.

The second paper is mainly concerned with Solid State Physics, Solid State Devices and Electronics. This course is quite important from the application aspects of modern electronic devices. It also forms the basis of advance electronics including communication technology to be covered at higher level.

The experiments are based mostly on the contents of the theory papers so as to provide comprehensive insight of the subject.

**PAPER - I
(Paper Code-3763)
RELATIVITY, QUANTUM MECHANICS, ATOMIC MOLECULAR
AND NUCLEAR PHYSICS**

Course learning outcome
This course will enable the student to get familiar with quantum mechanics formulation.

C01: Recapitulate and learn the special theory of relativity- postulates of the special theory of relativity, Lorentz transformations on space-time, space-time invariant length, length contraction, time dilation, mass-energy relation, Doppler effect, problems involving energy momentum conservations.

C02: know main aspects of the inadequacies of classical mechanics and understand historical development of quantum mechanics and ability to discuss and interpret experiments that reveal the dual nature of matter.

C03: Understand the theory of quantum measurements, wave packets, wave properties of particles, De Broglie waves and uncertainty principle. Students also understand the idea of Wave Mechanics and gain the concept of eigen values, eigen functions and learn the basic postulates of quantum mechanics

C04: Understand the central concepts of quantum mechanics: wave functions, momentum and energy operator, the Schrodinger equation, time dependent and time independent cases, probability density and the normalization techniques, skill development on problem solving e.g. one dimensional rigid box, tunneling through potential barrier, step potential, rectangular barrier. This course shall develop an understanding of how to model a given problem such as hydrogen, particle in a box etc. atom etc using wave function, operators and solve them.

C05: Learn the ground state properties of a nucleus – the constituents and their properties, mass number and atomic number, relation between the mass number and the radius and the mass number, average density, range of force, saturation property, stability curve, the concepts of packing fraction and binding energy, binding energy per nucleon vs. mass number graph, explanation of fusion and fission from the nature of the binding energy graph.

C06: Know about the nuclear models and their roles in explaining the ground state properties of the nucleus –(i) the liquid drop model, its justification so far as the nuclear properties are concerned, the semi-empirical mass formula, (ii) the shell model, evidence of shell structure, magic numbers, predictions of ground state spin and parity, theoretical deduction of the shell structure, consistency of the shell structure with the Pauli exclusion principles.

C07: Learn about the process of radioactivity, the radioactive decay law, the emission of alpha, beta and gamma rays, the properties of the constituents of these rays and the mechanisms of the emissions of

these rays, outlines of Gamow's theory of alpha decay and Pauli's theory of beta decay with the neutrino hypothesis, the electron capture, the fine structure of alpha particle spectrum, the Geiger-Nuttall law, the radioactive series.

C08: Learn the basic aspects of nuclear reactions, the Q-value of such reaction and its derivation from conservation laws, The reaction cross-sections, the types of nuclear reactions, direct and compound nuclear reactions, Rutherford scattering by Coulomb potential.

C09: Understand fission and fusion well as nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars, and also learn about the detectors of nuclear radiations- the Geiger-Mueller counter, the scintillation counter, the photo-multiplier tube, the solid state and semiconductor detectors.

C010: Study the Bohr Atom model in detail and understand about atomic excitations

PAPER-II
(Paper Code-3764)
SOLID STATE PHYSICS, SOLID STATE DEVICES AND ELECTRONICS

Course learning outcome:
At the end of the course the student is expected to assimilate the following and possesses basic knowledge of the following.

C01: Have a clear picture of crystal structures and a brief idea about crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, and concept of Brillouin zones and diffraction of X-rays by crystalline materials.

C02: Knowledge of lattice vibrations, phonons and in depth of knowledge of Einstein and Debye theory of specific heat of solids.

C03: At knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss. Secured an understanding about the dielectric and ferroelectric properties of materials. Learn to carry out experiments based on the theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop. They will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.

C04: Understanding the band theory of solids and must be able to differentiate insulators, conductors and semiconductors.

C05: To characterize various devices namely PN junction diodes, LEDs, Zener diode, solar cells, PNP and NPN transistors. Also construct amplifiers and oscillators using discrete components. Demonstrate inverting and non-inverting amplifiers using op-amps. N- and P- type semiconductors, mobility, drift velocity, fabrication of P-N junctions; forward and reverse biased junctions.

C06: Biasing and equivalent circuits, coupled amplifiers and feedback in amplifiers and oscillators.

C07: About analog systems and digital systems and their differences, fundamental logic gates, combinational as well as sequential and number systems.

C08: Synthesis of Boolean functions, simplification and construction of digital circuits by employing Boolean algebra.

LAB COURSE Physics

At the successful completion of the laboratory course the student is expected to acquire hands on skills/ knowledge on the following:-

i. Measurement of voltage and frequency of a periodic waveform using CRO, construct all logic gates using NAND as a building block, synthesize digital circuits and simplify them using Boolean algebra, construct adders/subtractors and binary adders and Adder-Subtractors, necessary skills/ hands on experience /working knowledge on multimeters, voltmeters,ammeters, electric circuit elements, dc power sources, ac/dc generators, inductors, capacitors, transformers, single phase and three phase motors, interfacing dc/ac motors to control and measure, relays and basics of electrical wiring.

LAB COURSE Physics

In the laboratory course, the students will get opportunity to perform the following experiments

1. Measurement of Planck's constant by more than one method.
2. Verification of the photoelectric effect and determination of the work Function of a metal.
3. Determination of the charge of electron and e/m of electron.
4. Determination of the ionization potential of atoms.
5. Determine the wavelength of the emission lines in the spectrum of Hydrogen atom.