Program : B.Sc. Physics

PO(Program Outcome)

Program Outcome:

Physics deals with a wide variety of physical systems and various phenomena. Certain theories are used by all physicists. Each of these theories were experimentally tested numerous times and found to be an adequate approximation of nature. Physics uses mathematics to organize and formulate experimental results. From those results, precise or estimated solutions, quantitative results from which new predictions can be made and experimentally confirmed or negated.

Undergraduates who successfully complete the physics major will have…

- Gained knowledge, skills, and proficiency appropriate to their degree in the key topic areas like classical mechanics, Optics, electricity and magnetism, basic electronics, solid state physics thermodynamics and statistical physics, modern physics including quantum mechanics, relativity, atomic physics and spectroscopy, plasma physics and holography and fibre optics, Energy technology and experimental methods.
- In addition to these core subjects, students will gain breadth of knowledge in several more advanced or specialty areas important for graduate study and careers by completing the upper level electives subjects like Instrumentation, Electronics and Optoelectronics , Vacuum Science and technology, Space and Astro physics, required in each semester.

Program : B.Sc. Physics

PSO(Program Specific Outcome)

- Critical Thinking for a given Physical Problem
- Problem solution approach
- Acquire good knowledge and understanding in advanced and frontier areas of Physics.
- Formulate and use quantitative mathematical models
- Demonstrate a rigorous understanding of the core theories & principles of physics, which includes mechanics, electromagnetism, thermodynamics, & quantum mechanics.
- Learn the concepts as Quantum Mechanics, Relativity,
- Demonstrate engagement with current research and developments in the subject introduced at degree level in order to understand nature at atomic levels.
- Provide knowledge about material properties and its application for developing technology to ease the problems related to the society.
- Understand the set of physical laws, describing the motion of bodies, under the influence of system of forces.
- Understand the relationship between particles & atom, as well as their creation & decay.
- Relate the structure of atoms & subatomic particles.
- Understand physical properties of molecule the chemical bonds between atom as well as molecular dynamics.

- Analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.
- Learn the structure of solid materials & their different physical properties along with electronics& material science.
- Understand the fundamental theory of nature at small scale & levels of atom & sub-atomic particles
- Career Opportunities exist in teaching in schools & Colleges (after M.sc., B.Ed/Net/Ph.D) where any of the science subjects is an important discipline.
- Careers as a Physicist in premier Research Organization like IPR, ISRO, PRL, DRDO etc.
- Careers in Industries in Testing and validation department.
- Entrepreneurship for small scale industries like electronics components, LED manufacturing, LASER cutting, Non-destructive Testing etc.
- Research and analysis in private organizations.

Program : B.Sc. Physics

CO(Course Outcome)

CC PHY-101

After successfully completion of the course, the student will be able to …

- To acquire knowledge of basic vector algebra and apply it to various physical problems. This will enhance the mathematical capability of student as well as their approach to various physical aspects through mathematics.
- Understand the extension of basic simple harmonic motion problem from school level to under graduate level.
- To develop basic understanding and analyzing about the working of DC circuits and its network. This will also motivate students to do hands on practice on electronic circuits in experimental and practical work.
- To learn the basics of thermodynamics and understand the behavior of thermodynamical systems under various conditions and varying thermodynamical parameters. Students can explore its applications in molecular dynamics, statistical mechanics, physical chemistry and other related areas.
- Learn basic understanding of rectifiers, filter circuits, and its working and construction and operation of various types of Transistors.

BSPHY101ES(Instrumentation Measurement and analysis)

After successfully completion of the course, the student will know …

- The efficient usage of the laboratory apparatus
- Process of measurements with minimal error (human / instrumental) andestimation of the same

PC PHY-101

After successfully completion of the course, the student will trained for

- Efficient usage of the laboratory apparatus

- To validate the theoretical concepts studied so far
- Thinking practical and analytical approach about basic electronic circuits

CC PHY-201

After successfully completion of the course, the student will be able to

- Classical ideas about the system of a particle and a system of particles will be explored. Students will be able to learn about the dynamical variables for such cases.
- Basic idea of central force filed and its application to planetary motion.
- Derivation, estimation and determination of trajectories of moving bodies under central force field problem.
- Introduction to geometrical optics and various phenomena related to light such as refraction and interference through different optical tools.
- Basic concept of Coulomb's law and forces between static charges, Calculation of electric field for given charge distributions. Basic theory and application of Gauss's law, Laplace and Poisson's equation.
- Basics of electric current and electric current density. Importance of equation of continuity and related problems. Elementary idea about electrical conductivity of metals and the Ohm's law. Understanding Kirchhoff's laws.
- Idea about resonance frequency in resonator. Equation that relates tensile force and various modes of string.
- Introduction to ultrasonic waves, its production, properties, applications and detection of ultrasonic waves.

BSPHY203ES (Electronic Circuit Elements & Energy Sources)

After successfully completion of the course, the student will be able to …

- Enhance their experimental skill and efficient usage of the laboratory apparatus.
- Improve their basic understanding and application of various passive circuit components.
- Understand importance and application of primary and secondary cells for various electronic circuits.

PC PHY-201

After successfully completion of the course, the student will be able to …

- Enhance their experimental skill and efficient usage of the laboratory apparatus.
- Validate the theoretical concepts studied so far.
- Gain practical approach about basic electronic circuits.
- Along with the experimental skills, analytical approach will also be developed.

CC PHY-301

After successfully completion of the course, the student will be able to …

- Learn about various characteristics functions. Along with that Maxwell's equations that relates thermodynamical parameters, concepts of compressibility and Expansivity as well as process of liquefaction of gases using Joule-Kelvin effect is explored.
- Understand ideas of classical molecular dynamics using concepts of statistical thermodynamics.
- Learn basic idea about diffraction phenomena, types of diffractions including Fresnel and Fraunhoffer, single slit-double slits extended to N slits. Also basics of diffraction grating are discussed.
- Learn about crystals and amorphous materials, their symmetries, coordination numbers and various crystal structures viz. BCC, FCC, SC etc.
- Understand fundamental theories and concepts of Atomic physics.
- Know about shortcomings of classical mechanics and emergence of quantum mechanics, 1D / 3D Time dependent Schrödinger equation for a particle and the concept of box normalization is discussed using quantum mechanical operators.

CC PHY-302
LEARNING OUTCOMES:
After successfully completion of the course, the student will be able to …

- Understand, in continuation with chapters learnt earlier, basic idea on Dielectrics, Solids, Liquids and Gaseous dielectrics.
- Learn about magnetic potentials, Vector potentials, and basic idea on Magnetization, Susceptibility and Permeability etc.
- In continuation to the chapter learnt earlier, learn about transistor biasing and stabilization factors.
- Learn about basics of Transistor Amplifier circuit, various types of Amplifiers and their Mathematical analysis.
- Study Fourier series, complex form of Fourier series and practice to solve related problems.
- Know an elementary idea about co-ordinate transformation, curvilinear co-ordinate system etc.
- Gain knowledge of fundamental concepts on relativity, Michelson-Morley experiment, Introduction to Special theory of relativity, Lorentz transformation, Length contraction, time dilation, Space time etc.

BSPHY301ES (Vacuum Pumps, Pressure Gauges and Instruments)
After successfully completion of the course, the student will be able to …

- Understand theoretical idea of the sophisticated laboratory instruments which are used in industries and research / academic institutes.
- Understand about the working and application of various vacuum pumps for generating high/low scale vacuum or pressure and measuring those using different gauges.
- Explore the construction, working and applicability of various optical/electrical instruments used in laboratory.

PC PHY-301, PC PHY-302
After successfully completion of the course, the student will be able to …

- Enhance skill and efficient usage of the laboratory apparatus.
- To validate the theoretical concepts studied so far.
- Gain practical approach about basic electronic circuits.
- Along with the experimental skills, develop analytical approach will also be developed.

CC PHY-401

After successfully completion of the course, the student will be able to …

- Understand, in continuation with chapters of solid state physics learnt earlier, basic concepts on cohesion of atoms and various types of bonding between atoms that lead to crystal structures and their physical properties viz. elastic constant like stress, strain, stiffness, bulk modulus and compressibility etc. are introduced here.
- Know and understand the physical interpretation of wave function 'Ψ', probability conservation, expectation value of observables, Ehrenfest's Theorem – A correspondence with Classical Mechanics, TIDSE for a particle, square well potential problem and related topics.
- Learn about fourth state of matter-Plasma is introduced with basic ideas. The basics of plasma including its composition and characteristics, properties, gas discharge, diagnostics and various phenomena related to plasma science.
- Learn about dynamics of a charge particle under magnetic and electric field in this context.
- Understand and determine the resolving power for telescopes and plane diffraction grating, as well as conceptualize the phenomena of Polarization of light, double refraction, various wave plates and production / detection of elliptically polarized light.

CC PHY- 402

After successfully completion of the course, the student will be able to …

- Understand, in continuation with chapters of electronics learnt earlier, basic concepts on electromagnetic induction, and applying the concepts for calculating Earth's horizontal / vertical magnetic field components.
- Explore AC bridges viz. Maxwell, Schering etc.
- Know about various number systems (Binary, Hexadecimal & Octal), Construction and application of X-OR gate-discussing adder and subtractor circuits.
- Learn about basics of C language – discussion on the history, applications, understanding of basic syntax and writing and executing basic level C programs relating to mathematics and physics.
- Get informed about radioactive growth and decay, different equilibrium etc., types of Nuclear reactions and relation with the Q-equation.
- Learn about atomic and molecular spectra, Stern Gerlach Experiment as well as Zeeman Effect – Normal and anomalous, Paschan back effect etc.

BSPHY402ES (Astro/ Space Physics)

After successfully completion of the course, the student will be able to …

- Get informed about Space Science specifically about solar structures, layers, composition, various features and related topics.

- Get informed about origin of cosmic rays, its types, Earths' geomagnetic relation with cosmic rays etc.

PC PHY-401, PHY-402

After successfully completion of the course, the student will be able to …

- Get skilled and efficient in usage of the laboratory apparatus.
- Understand and usage of basic electronic components for making of electronic circuits.
- Validate the theoretical concepts studied so far.
- Help students to gain practical approach about basic electronic circuits.
- Along with the experimental skills, developed analytical approach.

CC: PHY-501

After successfully completion of the course, the student will be able to …

- Learn method of separation of variables, Helmholtz equation for – Cartesian coordinates, Spherical coordinates & cylindrical coordinates, and Laplace equations. Also, an introduction to series solution method, discussion of singular points, ordinary points, etc.
- Learn Lagrangian formulation, a comprehensive discussion on Euler-Lagrange's equation of motion including the ideas of constraints, generalized co-ordinates, cyclic co-ordinates etc., The Euler's equation of motion for rigid body case.
- Learn about Schrodinger equation, postulates of wave mechanics, operators, etc. Along with this, a detail study on eigenvalue problems, eigen functions and degeneracy.

CC: PHY-502

After successfully completion of the course, the student will be able to …

- Learn concept of Microscopic / Macroscopic systems, Phase space, μ-Space etc, Postulate of equal a priori probability. Moreover, introducing Statistical Ensembles – Micro-canonical / Canonical / Grand-canonical, Maxwell Boltzmann distribution and related topics.
- Understand the Free Electron Theory Model using the Fermi Dirac distribution, the density of states, Sommerfield Model, Hall coefficients, etc.
- Learn qualitative description of dielectric constant, application to plasmons, polaritons, and polarons. This will be also helpful to find plasma oscillations, various optical modes for plasma and ionic crystals.
- Learn, in continuation with chapter of plasma science studied in earlier semester, characteristics and properties of plasma is studied under magnetic field. This includes force on plasma, current in magnetized plasma, diffusion, collision in fully ionized plasma, pinch effect, electromagnetic oscillations and resonances. Based on knowledge on plasma, its application in controlled thermonuclear reactor, which includes Lawson criterion, heating and confinement, radiation loss of energy and plasma propulsion etc.

This unit is extremely helpful to students who wish work or join in research institute dedicatedly work on plasma science.

CC PHY-503

After successfully completion of the course, the student will be able to …

- Learn about Alpha Rays (range, energy, paradox etc.), Beta rays (Continuous spectrum, Neutrino hypothesis, Fermi Theory) and Gamma rays (Emission, selection rules, etc.).
- Get informed about complete Fission process and related parameters are discussed followed by the Nuclear reactor physics. Moreover, about Elementary particles with their symmetry rules, conservation principles& fundamental interactions.
- Learn advanced concepts on Molecular spectra. About Pure rotational and vibrational-rotational spectra which are one of the key components in Molecular spectroscopy. Its salient features, molecular requirement, experimental arrangements and Molecule as a rigid rotator and non rigid rotator etc. topics.
- Know basic study of molecular structure through Raman Effect, Nature of Raman Effect, its experimental arrangement, classical theory and quantum theory of Raman Effect, its salient features, also basics of molecular spectra.

CC PHY-504

After successfully completion of the course, the student will be able to …

- Learn, again in continuation with earlier chapters of electronics, to reduce complicated network in to simplified network of electronics circuit. This includes conversion between T and π sections, bridged-T network, parallel T-network; based on this, Point impedance, transfer impedance etc. theoretical aspects.
- Along with basic circuit analysis part, know about photo electronics devices, photovoltaic cells with its applications as SCR, DIAC, TRIAC etc.
- Understand about basic transistor amplifiers including CE amplifier with Emitter resistor, hybrid model and effect on an emitter bypass capacitor. Further, multistage amplifiers in detail.
- Learn theoretical aspects of Regulated DC Power Supply are discussed in detail viz. Transistor Series voltage Regulator, Negative Feedback Voltage Regulator etc.
- In continuation with earlier chapter, learn the next level concepts of "C" language including Character Set, Keywords and Identifiers, Variables etc.

BSPHY501ES (Instruments)

After successfully completion of the course, the student will be able to …

- Get inform about this particular subject focuses on different instruments frequently used in UG and PG level laboratories as well as research and academic institutes.

PC PHY-501, PHY-502, PHY-503, PHY-504

After successfully completion of the course, the student will be able to …

- Get skilled and efficient in usage of the laboratory apparatus.
- Validate the theoretical concepts studied so far.
- Help students to gain practical approach about basic electronic circuits.
- Along with the experimental skills, developed analytical approach.

CC PHY-601

After successfully completion of the course, the student will be able to …

- Learn Again in continuation with earlier chapters, in mathematical physics concepts on curvilinear co-ordinate system and special functions viz. Legendre polynomials and Hermite polynomials to solve higher order differential equation and to understand and solve mathematical models are introduced.
- Extend Lagrangian mechanics and thereby switching over to Hamilton's principle.
- Perform calculation and analysis of eigen value problem for simple harmonic. Also a complete chapter on angular momentum algebra will be learned.

CC PHY-602

After successfully completion of the course, the student will be able to …

- Get informed about the basic laws of Thermodynamics, applications of statistical mechanics along with which Gibb's paradox and equipartition theorem.
- Learn concepts of partition function for different cases using BE / FD distribution.
- Learn complete basic theory of superconductivity (Type-I & Type-II) along with the BCS theory. This may help students to work in industries and research institutes.
- Get informed about the basics of Holography and its applications and about Optical Fibers (construction, working and merits-demerits) and Fiber Optics communication system.

CC PHY-603

After successfully completion of the course, the student will be able to …

- Learn about Laplace equations, Uniqueness theorem, problems based on images are derived and the concepts of Multipole expansion.
- Learn and extend their understanding about Maxwell's equations, scalar and vector potential and Gauge transformations.
- Deduce Maxwell's wave equations for **E**& **B** fields in vacuum.
- Get informed about fundamental of Solar Energy (Limitation, Merits-Demerits, applications, conversion systems and solar cells etc.).

CC PHY-604

After successfully completion of the course, the student will be able to …

- Learn, In line with earlier chapters, basics of Feedback amplifiers. Also, to learn basic transistor oscillator circuit viz. Hatley Oscillator,Colpitt's Oscillators, Wien Bridge Oscillator etc.
- Learn concepts of voltage modulation, modulated power, frequency modulation, phase modulation etc.
- Learn concept on Digital electronics, Karnaugh Maps, BCD-to-7 Segment Decoder, Comparator, Multiplexer, Demultiplexer etc.
- Learn more on programming of C, Operators and expression in C, some computational problems. Also, with reading and writing characters (Input / Output characters) and if-else, Goto statement (Decision making and branching statements).

BSPHY501ES (Instruments)

After successfully completion of the course, the student will be able to …

- Get informed about Optical analogy for LASERS including various types of LASERS, applications etc.
- Learn working Principle, measurements and determination and application of Fabry-Parot Interferometer and Etalon and Electron microscope.
- Helps students to work with industries and research institutes working on Opto-electronics.

PC PHY-601, PHY-602, PHY-603, PHY-604

After successfully completion of the course, the student will be able to …

- Get skilled and efficient in usage of the laboratory apparatus.
- Validate the theoretical concepts studied so far.
- Help students to gain practical approach about basic electronic circuits.
- Developed analytical approach along with the experimental skills.