Department of Physics
Basirhat College

Course Outcomes of 3 Year B.Sc. Honours Course in Physics under

Choice Based Credit System (CBCS)

Table of Contents

Course Outcomes for Core Courses

Mathematical Physics-I (PHSACOR01T and PHSACOR01P)

Course description

The aim of this freshmen level course is to introduce to the students advanced calculus including ordinary differential equations, vector calculus and the theory of probability and statistics.

Course Outcomes

CO1 : Understanding of the elements of functional analysis like power series, exact and inexact differentials, constrained maximization using Lagrange multipliers.

CO2 : Understanding of initial and boundary value problems. Learn to solve first and second order ordinary differential equations.

CO2 : Understanding of geometric and algebraic nature of vector calculus. Learn differentiation and integration involving vectorial quantities. Knowledge about curvilinear coordinates and their usefulness to exploit symmetries in physical systems. Develop confidence in the application of vector calculus to the problems of mechanics and electrodynamics.

CO4 : Comprehend elementary concepts of probability and statistics like Bayes theorem and the probability distributions.

CO5 : Learn plotting functions and data, curve fitting and least square method using QtiPlot. Use python to solve simple mathematical problems.

Mechanics (PHSACOR02T and PHSACOR02P)

Course description

 The aim of this course is to familiarize the students with the idea of Mechanics, General Properties of Matter, Oscillation and Special theory of Relativity.

Course Outcomes

CO1 : Understanding of inertial and non-inertial frames. Learn about Galilean transformations, conservation laws and dynamics of system of particles. Learn about conservative and non-conservative forces, potential energy, equilibrium conditions, work and kinetic energy theorems.

CO2 : Learn about elastic and non-elastic collisions. Learn about angular momentum of a system of particle, moment of inertia and related theorems and applications.

CO3 : Understanding of elastic constants and relations between them. Learn kinematics of moving fluids and equation of continuity.

CO4 : Learn about the laws of gravitation, motion under central force field and Kepler's laws.

CO5 : Understand simple harmonic oscillator. Understanding of damped and forced oscillation, sharpness of resonance, power dissipation and Quality factor.

CO6 : Understanding of the postulates of special theory of relativity, Lorentz transformation, relativistic addition of velocities.

Electricity and Magnetism-I (PHSACOR03T and PHSACOR03P)

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

CO2 : Understanding of the statistical nature of electricity and magnetism in matter, linear response of material bodies to external fields and conservation laws.

CO3 : Learn a host of techniques to solve idealized yet close to real life examples involving electromagnetic phenomena.

CO4 : Understanding of the electric circuits and their characteristic behavior.

CO5 : Acquire hands-on experience about the electric circuits in the laboratory.

Waves and Optics (PHSACOR04T and PHSACOR04P)

Course description

The aim of this course is to familiarize students with wave motion, superposition of waves, wave optics, Interference and Diffraction of light waves and Holography.

Course Outcomes

CO1 : To learn about the superposition of oscillation and types of waves.

CO2 : To learn about the longitudinal and transverse wave. To understand the propagation of waves through different media.

CO3 : To create an idea about the formation of standing waves. To analyze the energy and modes of standing wave.

CO4 : To gather knowledge on interference, fringes, Bi-prism, Newton's Ring and Interferometers.

CO5: To understand the concept of diffraction, slit, zone plate and analyze the resolving power of different optical devices.

CO6: To create an idea about holography and holograms.

Mathematical Physics-II (PHSACOR05T and PHSACOR05P)

Course description

The aim of this course is to introduce Fourier series, Frobenius method to solve differential equation, special functions (Legendre, Hermite, Laguerre, Bessel, Airy), special integrals (Gamma and Beta function), elementary idea about partial differential equation, calculus of variation and analytical dynamics.

Course Outomes

CO1 : Learn expansion of functions in Fourier series. Understand the difference between power series and Fourier series, Gibbs phenomena and probability conservation (Parseval relation). Familiarity with the application of Fourier series in physics, e.g, in signal processing.

CO2 : Learn the method of power series solution of differential equation. Solve Hermite, Laguerre, Bessel, Legendre equations using Frobenius method. Understand generating functions, recurrence and orthogonality relation and completeness property of orthogonal polynomials. Ability to solve problems in electrodynamics and physical optics.

CO3 : Learn calculus of variation and analytical dynamics and application to classical mechanics**.**

CO4 : Familiarity with the complete and incomplete Gamma function and Beta function.

CO5 : Develop basic understanding of partial differential equation.

CO6 : Learn numerical methods like sorting, interpolation, differentiation, integration and solution of ODE. Ability to write the corresponding codes in Python.

Thermal Physics (PHSACOR06T and PHSACOR06P)

Course Description

This is an introductory course to give students the concepts of the kinetic theory of gases and fundamental principles of thermodynamics.

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.

CO2 : Understand reversible and irreversible process, conversion between heat and work, Carnots's Theorem, Heat engines and their efficiency. Understand entropy, 2nd law in terms of entropy, evaluate entropy changes in a wide range of processes, concept of absolute zero.

CO3 : Understand Thermodynamic Potentials, Enthalpy, Free Energy, Phase Transitions, Clausius Clapeyron equation.

CO4 : Acquire knowledge in the Kinetic theory of gases, molecular collisions. Understand the process of thermal conductivity, viscosity and diffusion in gases, behavior of real and ideal gases.

CO5 : Develop understanding of the practical applications of the concepts learned in the theory course through hands-on experiments in the laboratory.

Digital Systems and Applications (PHSACOR07T and PHSACOR07P)

Course Description : The objective of this course is to provide the students with the basic ideas of Electronics, Integrated circuits with an emphasis on Digital electronics.

Course Outcomes

CO1 : Understand fundamentals of Electronic Components and Measuring devices and the basics of ICs.

CO2 : Understand about various number systems and their conversion. Will be able to design different logic circuits and gates. Learn about SOP and Karnaugh map theory and their uses.

CO3 : Acquire knowledge about binary addition, subtractions and data processing circuits like multiplexer de-multiplexers, decoders, encoders and their design.

CO4 : Developed knowledge about different flip-flops and their design. Learn about IC 555 and their uses.

CO5 : Learn about different registers and counters. Understand fundamentals of computer organization.

Mathematical Physics-III (PHSACOR08T and PHSACOR08T)

Course Description

This course introduces complex analysis, Fourier transform, boundary value problems, matrices and eigen-systems.

Course Outcomes

CO1 : Comprehend complex analysis and apply knowledge to diverse problems of physics.

CO2 : Understanding of integral transforms and ability to use them to solve some partial differential equation like heat equation and wave equation.

CO3 : Learn to solve the boundary value problems and apply the concepts to the problems of electrodynamics.

CO4 : Understand properties of Matrices and learn to solve eigen-systems.

CO5 : Learn to numerically solve the class of problems cited in CO1-C04 using in Python.

Elements of Modern Physics (PHSACOR09T and PHSACOR09P)

Course Description

This is an introductory course to give students a glimpse of relativistic dynamics, development of quantum mechanics as correct physical theory in subatomic level, atomic and nuclear physics and LASER.

Course Outcomes

On successful completion of this core course students will

CO1 : Acquire knowledge of Lorentz transformation, Understand the concept of relativistic mass, relationship between mass and energy.

CO2 : Acquire knowledge on the classical approach to deal with the large collection of identical entities in an enclosure at thermal equilibrium, classical theory of blackbody radiation, Rayleigh-Jeans law.

CO3 : Appreciate the failure to classical physics to describe phenomena at subatomic level, concept of quantum theory, blackbody radiation, photoelectric effect, Compton effect. Understand wave particle duality and Heisenberg uncertainty principle.

CO4 : Acquire knowledge about LASER, Einstein's coefficients.

CO5 : Understand the structure of atomic nucleus, nuclear models, radioactivity, alpha and beta decay, gamma ray emission, nuclear fission and fusion.

Analog Systems and Applications (PHSACOR10T and PHSACOR10P)

Course Description : The objective of this course is to provide the students with the basic ideas of Analog Electronics.

Course Outcomes

CO1 : Acquire basic knowledge about the development of electronics and advantage of solid state devices in electronics.

CO2 : Students will get basic idea of semiconductors: P and N type semiconductors and their electrical properties. Basic ideas of PN junction diode with current flow mechanism.

CO3 : Will learn about two-terminal devices like half-wave and full-wave rectifier and their applications. Calculation of ripple factor and rectification efficiency. Ideas about C filter & π- filter. Will learn about Zener diode and its application in voltage regulation. Principle and structure of (1) LED, (2) Photo-diode and (3) solar Cell.

CO4 : Learn about bipolar junction transistors (n-p-n and p-n-p). Characteristics of CB, CE and CC configurations. Get idea of current gains α and β. Will get knowledge about DC Load line and Q-point.

CO5 : Will get basic ideas about the principle of operation of JFET.

CO6 : Learn about amplifiers including transistor biasing. Fixed Bias and Voltage Divider Bias. Learn about hybrid model and h-parameter. Will be able to analysis of a single stage CE amplifier using Hybrid Model. Get ideas of Classification Amplifiers (A, B and C).

CO7 : Basic knowledge of a two stage RC-coupled amplifier and its frequency response.

CO8 : Students will develop concept of feedback in amplifier. Effects of positive and negative feedback. Advantage of negative feedback.

CO9 : Learn about Sinusoidal Oscillators. Barkhausen's criterion for self-sustained oscillations. Will be able to design and construct RC, Hartley and Colpitts oscillators.

CO10 : Will get basic knowledge of Operational Amplifiers (OPAMP). Characteristics of ideal and real OPAMP. Learn about open loop and closed loop gain, CMRR, Slew Rate and Virtual ground.

CO11 : Learn about applications of Op-Amps: They will be able to design and construct following circuits : (1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor,

(4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator. Non-linear – (1) inverting and non-inverting comparators, (2) Schmidt triggers.

Quantum Mechanics (PHSACOR11T and PHSACOR11P)

Course Description

The objective of this course is to introduce to the students the ideas of quantum mechanics and its application in atomic physics.

Course Outcomes

CO1 : Understanding of the failure of classical concepts to describe the physics at the sub-atomic scale and emergence of the quantum mechanics and appreciation of the discrete and probabilistic nature of this theory.

CO2 : Knowledge about the Schroedinger equation and its analytic and numerical solution.

CO3 : Understanding of the bound states in different potentials.

CO4 : Knowledge about the application of quantum mechanics in the atomic systems.

CO5 : Learn to numerically solve Schroedinger equation for different potentials.

Solid State Physics (PHSACOR12T and PHSACOR12P)

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, 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 solids, Brillouin Zones, Diffraction of X-rays, Lattice vibrations and spectrum of Phonons, Theories of specific heat of solids.

CO2 : Magnetic Materials ; Theories of Diamagnetism, Paramagnetism and Ferromagnetism; Hysteresis and energy Loss.

CO3 : Polarization, Dielectric Susceptibility, Clausius Mosotti equation, Dispersion and Cauchy relations, Ferroelectric materials, Curie-Weiss Law, Ferroelectric domains, P-E hysteresis loop

CO4 : Drude's theory, effective mass, Hall Effect in metals, Kronig-Penny model, Band Gap, Conductivity of Semiconductor.

CO5 : Superconductivity, Meissner effect, Types of Superconductors, London's equation, Isotope effect.

CO6 : Hands on experiments on what they have assimilated in the theory course.

Electromagnetic Theory (PHSACOR13T and PHSACOR13P)

Course Description

The objective of the course on Electromagnetic theory is to introduce to the students unified description of electric and magnetic phenomena. Starting with the derivation of Maxwell's equations, electromagnetic waves and their polarization, reflection and refraction, dispersion and scattering are studied. Basic idea of wave guides and optical fibers are introduced.

Course Outcomes

CO1 : To create an idea on Maxwell equation, Gauge Transformation, Poynting theorem

CO2 : To derive and analyze Wave equation, Wave propagation in bounded and Unbounded Media

CO3 : To understand the idea of Polarization of electromagnetic Wave, Optical rotation, Polarimeter

CO4 : To understand the propagation of electromagnetic waves in anisotropic media and correlated consequences.

CO5 : To gain knowledge about the wave guides and basic idea about optical fibres.

Statistical Mechanics (PHSACOR14T and PHSACOR14P)

Course Description : Statistical Physics core is an introductory course to inculcate among the students an understanding of classical statistical mechanics, blackbody radiation, system of identical particle and three different statistical distributions (MB, BE and FD distributions).

Course Outcomes

On successful completion of this core course students will

CO1 : Understand the classical statistical mechanics in particular: Macrostates and microstates, entropy, temperature, ensemble, chemical potential, partition functions.

CO2 : Have an idea of chemical equilibrium, chemical potential and ionization potential.

CO3 : Acquire knowledge of blackbody radiation, different laws relating to radiation and Planck's Law.

CO4 : Understand identical particles and indistinguishability, derivation of the Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics and their applications in different physical systems.

CO5 : Acquire familiarity with the computational analysis of different velocity distributions, partition functions, plot of Planck's law for black body radiation.

Course Outcomes for Department Specific Elective Courses

Advanced Mathematical Physics–I (PHSADSE01T and PHSADSE01P)

Course Description

The objective of this course is to impart the students knowledge of Laplace transform and applications, abstract notions of linear vector spaces, coordinate transformations, cartesian and general tensors.

Course Outcomes

CO1 : Learn Laplace transform and its properties. Ability to solve second order differential equations and coupled first order differential equations using Laplace transform. Comprehend solution of heat equation by Laplace transform.

CO2 : Comprehend basics of linear vector space, properties of linear transformation in vector space and representation by matrices, inner products, orthogonal and unitary transformation.

CO3 : Comprehend coordinate transformation and definition of tensors. Understand the notations and able to express differential operators in tensorial notation. Understand how tensorial quantities arise in physics and grasp the meaning of moment of inertia tensor, stress tensor, elasticity tensor, energy momentum tensor.

CO4 : Understand general tensors. Grasp the meaning of contravariant and covariant tensors, kronecker delta and permutation tensors, metric tensor.

CO5 : Learn to numerically solve linear algebra problems by explicit coding using python.

Advanced Dynamics (PHSADSE02T)

Course Description

The objective of this course two fold : (a) it serves the purpose of supplementing PHSACOR02T and (b) it introduces in detail advanced concepts of dynamical systems.

Course Outcomes

CO1 : Understand Lagrange and Hamilton dynamics, constrained systems, canonical transformations and generating functions, Poisson bracket.

CO2 : Grasp well the mechanics of rigid body.

CO3 : Understand the small amplitude oscillations.

CO4 : Understand Eulerian ideal hydrodynamics, dissipative Navier Stokes hydrodynamics. Acquire preliminary idea about turbulence.

CO5 : Understand the basics of a dynamical systems, phase space, flows and trajectories. autonomous and non-autonomous systems, dimensionality and stability. Apply knowledge to study simple systems. Understand discrete time dynamical systems, iterative map. logistic map, cobweb iteration. Acquire basic idea of chaos and Lyapunov exponent.

Nuclear and Particle Physics (PHSADSE03T)

Course Description

The intent of this course is give the students a formal introduction to the Nuclear and Particle physics.

Course Outcomes

CO1 : Learn the ground state properties of nucleus. Acquire knowledge about nuclear models, nuclear stability, nuclear shell structure, concept of mean field, residual interaction and the concept of nuclear force.

CO2 : 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.

CO3 : Understand nuclear reactions, their types, conservation laws, kinematics, Q value, cross section. Understand compound and direct reaction, Coulomb scattering.

CO4 : Acquire knowledge about of the interaction of Nuclear Radiation with matter, Bethe-Bloch formula, Cerenkov emission, photoelectric effect, Compton effect, neutron interaction with matter. Acquire basic idea about different types of nuclear detectors. Acquire basic idea about different types of particle accelerators.

CO5 : Understand different types particle interaction, symmetries and conservation laws governing particle interactions. Acquire basic idea of quark model and color confinement.

Advanced Mathematical Physics–II (PHSADSE04T)

Course Description

This objective of this advanced level course is to provide the students rigorous training on partial differential equation, group theory and probability theory.

Course Outcomes

CO1 : Understand the classification of PDE and solution of the homogeneous equation of each type. Comprehend Green's function and solution of inhomogeneous PDE by Green's function method.

CO2 : Comprehend the basics of group theory, e.g, definitions, types of group, group operations. Learn about special groups, matrix representation, reducibility *of the* groups, Schur's lemma, Lie groups. Understand rotation group, and homomorphism between SU(2) and SU(3).

CO3 : Revise the theory of probability, random variables and probability distributions, expectation values and variance. Understand various examples of probability distributions used in physics. Learn the principle of least squares.

Astronomy and Astrophysics (PHSADSE05T and PHSADSE05P)

Course Description: The objective of this course is to introduce to the students the ideas of quantum mechanics and its application in atomic physics.

Course Outcomes

CO1 : Comprehend astronomical scales and understand basic concepts of positional astronomy.

CO2 : Understand astronomical techniques, types of optical telescopes and telescope mountings, detectors and their use with telescopes.

CO3 : Learn physical principles used in astrophysics like virial theorem for gravitating objects, systems in thermodynamics equilibrium.

CO4 : Understand basic parameters of stars, H-R diagram, Chandrashekhar limit. Learn the physics of sun and solar system, structure of sun, solar MHD, helioseismology, solar system and its origin. Understand nebular model, tidal forces and planetary rings. Acquire basic idea about extra solar planets.

CO5 : Acquire basic knowledge of the galaxies and the Milky Way, morphology and classification of galaxies, galactic structure, basic structure and properties of milky way, galactic nucleus.

CO6 : Learn about the large scale structure and expanding universe, cosmic distance ladder, distance measurements, cluster of galaxies, Hubble's law.

Communication Electronics (PHSADSE06T and PHSADSE06P)

Course Description

The aim of this course is to impart the students the concepts of electronic communication, modulations, communication and navigation systems and mobile telephony system.

Course Outcomes

CO1 : Understand fundamentals of communication, eletromagnetic communication spectrum and frequency bands.

CO2 : Understand different types of modulation and about super heterodyne receivers.

CO3 : Understand sampling, sampling theorem and multiplexing.

CO4 : Acquire knowledge about satellite communication including uplink and downlink.

CO5 : Understand mobile telephony system, technologies in mobile telephony (2G, 3G, 4G), GPS navigation.

CO6 : Acquire skills to design and use different types of transmitters, receivers, modulators and demodulators and multiplexers through hands on training in the laboratory.

Course Outcomes for Skill Enhancement 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.