PROGRAMME OUTCOME

&

COURSE OUTCOME

for

M. Sc & B. Sc in Physics

P. G. Department of Physics
N. C. Autonomous College
Jajpur - 755001, Odisha

SEPTEMBER 2024

PROGRAMME OUTCOMES: M. Sc. PHYSICS

PO1: Students should acquire a deep understanding of the core concepts of physics
PO2: Craft a foundation that will enable students to apply scientific and technical knowledge to solve complex problems, design and conduct experiments
PO3: Be motivated into research and innovation
PO4: Imbibe sound moral and ethical values
PO5: Become conscious about role of physics on environmental and societal development
PO6: Attain skills for communication and continuous professional development
PO7: Learn to tolerate diverse ideas, analyze different points of view and apply knowledge of physics to other disciplines and areas of study
PO8: Become empowered to address challenges of the societal demands and changing universe

COURSE OUTCOMES: M. Sc. PHYSICS

PHY 101: Classical Mechanics

- Understand the basic mechanical concepts related to discrete and continuous mechanical systems.
- Describe and understand planar and spatial motion of a rigid body and understand the motion of a mechanical system using Lagrange-Hamilton formalism.
- Demonstrate a working knowledge of classical mechanics and its application to standard problems such as central forces.

PHY102: Mathematical Methods in Physics

- Demonstrate the utility and limitations of a variety of powerful calculation techniques and to provide a deeper understanding of the mathematics and useful in theoretical physics.
- Understand elementary ideas in linear algebra, special functions and complex analysis.
- Will be able to apply these to solve problems in classical, statistical and quantum mechanics, electromagnetism as well as solid state physics.

PHY103: Quantum Mechanics - I

- State basic postulates of quantum mechanics
- Understand the Hermitian operators, projection operators, unitary operators etc.
- Solve Schrodinger equation of harmonic oscillator problem completely using operator method
- State addition of angular momentum theorems and spin angular momentum statistics
- Solve for the hydrogen atom using Schrodinger equation

PHY 104: Modern Physics and Optics (Practical)

- To verify experimentally some of the laws and principles associated with modern physics and optics.

PHY 201: Quantum Mechanics – II (Application to Atomic and Molecular Physics)

- Derive energy and wave function for physical system using time independent perturbation theory
- Derive transition probability under time dependent perturbation theory
- Explain Stark effect, origin of polarizability and dipole moment, fine structure of hydrogen atom and Zeeman effect
- Understand the dipole selections rules in various atomic transitions
- Solve the scattering cross-section for various scattering process such as black sphere scattering, hard sphere scattering and inelastic scattering
- Apply variational principle to find out the ground state energy of the various physical system

PHY 202: Classical electrodynamics

- Demonstrate and analyze Maxwell's wave equation in different media
- Derive scalar and vector potential in presence of different sources
- Derive the Poynting theorem
- Apply Gauge invariance condition to Maxwell's equation
- Derive Maxwell's equation in co-variant form
- Derive covariant form of Maxwell's equations
- Derive relation between reflection coefficient and absorption coefficient
- Calculate different modes of electromagnetic waves in waveguides
- Calculate angular distribution of radiation and power emitted by dipole
- Show that accelerating charge produce electromagnetic radiation

PHY203: Basic Condensed Matter Physics

- Understand the difference in direct space and Reciprocal lattice space
- Understand the mode of vibrations and Dispersion relation
- Derive Specific heat equation for the metal and insulator
- Derive the Law of mass action relation for the semiconductor material
- Understands the Cooper pair and energy gap in Superconductor

PHY 204: Computational Methods in Physics (Practical)

• Write computer programs using FORTRAN 90 and C
• Use different numerical methods to solve problems using computer programs.
• Simulate physical systems using Monte Carlo Method.

PHY 301: Advanced Quantum Mechanics

- Explain the relativistic quantum mechanical equations, namely, Klein-Gordon equation and Dirac equation.
- Describe second quantization and related concepts.

PHY 302: Electronics

- Explain frequency response of linear amplifiers, feedback amplifier
- Explain and design differential amplifier, sum and integrator etc
- Explain feedback criteria for oscillation, crystal-controlled oscillator, Klystron oscillator, principle of multivibrator
- Explain basic logic operations of NOT, AND, OR, NAND, NOR, XOR and flip-flops
- Explain basic principles of radio communications and antennas
- Explain basic principles optical fibers and electromagnetic wave propagation in optical fiber

PHY303a: Advanced Condensed Matter Physics-I

- Explain the significance and value of condensed matter physics, both scientifically and in the wider community.
- The subject treats materials from an experimental viewpoint, solid state theory and properties.
- Understanding of the interplay between classical – and quantum mechanical phenomena, in condensed matter physics.
- Demonstrate the electron-phonon interaction and second quantization
- Understand electron –ion interaction for energy gap in solid
- Understand the Transport properties

PHY 304: Electronics (Practical)

- Measure voltage, frequency and phase of any waveform using CRO.
- Generate sine, square and triangular waveforms with required frequency and amplitude using function generator.
- Analyze the characteristics of different electronic devices such as diodes, transistors etc., and simple
- circuits like rectifiers, amplifiers, OPAM etc.,

PHY 305a, 305b: Dissertation Project &Review of Literature

- The course enables students to learn basic research methodology.
- Learn how to define a research problem and perform research in order to address them.
- Train students to develop their presentation skill through seminars.
- Students develop skill to write research article and project dissertation.

PHY 401: Basic Nuclear and Particle Physics

- The course gives an understanding of the nucleus at low energy.
- The students develop basics to solve some of the problems of nuclear physics and their limitations in nature.

PHY402: Statistical Physics

- State postulates of classical and quantum statistical mechanics
- Differentiate between microstate and macrostate
- Tell the significance Gibb's paradox and indistinguishability in statistical mechanics
- Describe Planck's blackbody radiation relation, electronic specific heat in metals and Bose-Einstein condensation
- Describe thermodynamics of phase transition and formulate the Ising model of phase transitions for ferromagnetism.

PHY403b: Advanced Condensed Matter Physics-II

- State and Derive different mathematical form like the Curie –Weiss law for susceptibility
- Differentiate between magnetic and antiferromagnetic material
- Understant the Landau theory of phase transition
- Describe the Kramers-kronig relation for dielectric materials

PHY404b: Condensed Matter Physics lab

- How to determine the crystal structure, lattice parameter and crystallite size?

- Measurement and analysis of various types of transport.
- Optical characterization of solid.
- Magnetic and dielectric behavior of solids

PROGRAMME OUTCOMES: B. Sc. PHYSICS

PO1: Acquire adequate knowledge of the subject
PO2: Craft a foundation for higher learning
PO3: Be initiated into the basics of research
PO4: Imbibe sound moral and ethical values
PO5: Become conscious of environmental and societal responsibilities
PO6: Attain skills for communication and career
PO7: Learn to tolerate diverse ideas and different points of view
PO8: Become empowered to face the challenges of the changing universe

COURSE OUTCOMES: B. Sc. PHYSICS

Core I: Mathematical Physics-I

- Basic understanding of Differential equations and their solutions, conceptual understanding of calculus.
- Basic understanding of vector calculus and its differentiation.
- Use of vector calculus to understand vector integration. Dirac delta function and its properties.
- Understanding of orthogonal curvilinear coordinates and its application in vector differentiation.
- To understand the basic algorithm in application to functional algebra and error analysis.

Core I - LAB

- Highlights the use of computational methods to solve physical problems
- Evaluation done not on the programming but on the basis of formulating the problem
- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

Core II: Mechanics

- To Learn the basic concepts of Rigid body dynamics, Radius of Gyration, Moment of Inertia,Non-Inertial Systems
- To Understand the concept of Elasticity, Fluid motion and Types of Vibration

- To understand the concept of Newtonian theory through Gravitation, Central force motion, Keplar's laws, GPS
- To learn the concept of Special theory of Relativity, Michelson- Morley experiment, Lorentz transformation, Relativistic Doppler effect.
- Apply the basic concepts of Mechanics in experiments.

Core III: Electricity and Magnetism

- To understand the basic concepts of Electricity and Magnetism
- To Understand the various phenomena in Electricity and Magnetism
- To Understand Circuit analysis and network theorems
- To Explain the Dynamics of Charged Particles
- To Apply the acquired knowledge in Experiment.

Core IV: Mathematical Physics-II

- Conceptual understanding of Fourier series and its application in periodic function.
- Understanding the various special functions and its properties.
- Understanding various polynomials and special integrations.
- To learn the applications of partial differential equation.
- To apply the acquired knowledge to solve problems.

Core V: Waves and Optics

- Basic understanding of propagation of light, its application and wave nature.
- To Understand the concepts of wave motion.
- To Understand the concepts of interference and its application.
- To Understand the concepts of diffraction and its application.
- To Apply the acquired knowledge of optics in Experiment

Core VI: Mathematical Physics-III

- Understanding and application of Complex function variables.
- Understanding the concept of Fourier Integral transform.
- To Understand the properties and application of Fourier integral transformation.
- To Understand the properties and application of Laplace integral transformation.
- To Apply the acquired knowledge to solve problems.

Core VII: Thermal Physics

- Basic understanding of thermodynamics and various thermal variables.
- Understanding various thermodynamics potential applications and their properties.
- To Understand the concepts of ideal gas and its thermal properties.
- To Understand the concepts of real gas and its thermal properties.
- To Apply the acquired knowledge of thermodynamics in Experiments.

Core VIII: Analog Systems

- Basic understanding of semiconductor diodes, devices and their applications.
- To understand the basic concepts in transistors and amplifiers.
- To understand the concept of coupled amplifier and its application in feedback circuit.
- To understand the concepts of operational amplifier and its application.
- To apply the acquired knowledge of electronic circuits in Experiments.

Core IX: Basic Instrumentation

- Conceptual understanding of different measurement of electronic circuit with measuring devices. CO-2: Basic understanding of CRO and its applications.
- Basic understanding of signal generators and its analysis
- Basic understanding of digital instruments and their applications.
- To Apply the acquired knowledge of different electronic measurement-based instruments in Experiments

Core X: Nuclear and Particle Physics

- Understanding the properties of atoms in electric and magnetic field.
- Understanding the concept Nuclear physics.
- Conceptual understanding nuclear models and nuclear reactions.
- Conceptual understanding of particle physics.
- To Apply the acquired knowledge in conducting the experiments.

Core XI: Digital Systems

- To Understand IC's and scales of Integration, Digital Circuits and their realization, Applications
- Build strong knowledge about Boolean Algebra, Truth tables, Equivalent Circuits, Theory and application of CRO.

- Gain a clear understanding of Data processing circuits, Arithmetic Circuits, different types of Timers: IC 555
- To Explain the knowledge of computer organization, Shift registers and counters.
- To Apply the acquired knowledge to realize various types of circuits in experiment

Core XII: Quantum Mechanics and Applications

- To understand Properties and physical interpretation of wave function and its application, knowledge in probability current density, significance of momentum space transformation and time dependent Schrödinger equation.
- To explain Time independent Schrödinger equation, Eigen value, Eigen function, generalized solution of stationary states, knowledge in wave function and discrete energy level.
- Basic knowledge in quantum mechanical operators, Eigen value and Eigen function, Uncertainty relation and Gaussian wave packet.
- Acquire the knowledge in application of Schrödinger equation in different potential barriers, concept of simple harmonic oscillator.
- Apply the acquired knowledge to solve various numerical problems.

Core XIII: Solid State Physics

- To understand the Concept of crystal structure and properties, X-ray Diffraction, Bragg's and
- Laue's condition.
- Conceptual understanding of Lattice vibration, Einstein and Debye specific heat theories of solids, knowledge in Band theory, Kroning-Penny model and Hall Effect.
- Understanding the Concept in magnetic and dielectric properties of materials.
- Basic knowledge on LASER and its generation, types. Conceptual understanding of superconductivity and its type, London's Equation, Penetration Depth and BCS theory.
- To Apply the acquired knowledge in experiments.

Core XIV: Electromagnetic Theory

- Physical significance of Maxwell Equation and its application to free space, Lorentz and Coulomb gauge transformation, poynting theorem, concept of energy density.

- Analysis of Maxwell's equations in different media and Physical significance of relaxation time, skin depth, Electrical conductivity of ionized gases, plasma frequency.
- Basic understanding of polarization of EM wave, and different types of crystals, Phase
- Retardation Plates and Rotatory Polarization.
- Conceptual understanding of EMW application in bounded media, plane interface, dielectric media, Brewster's law, TIR, Evanescent wave, metallic reflection.
- To Apply the acquired knowledge for visualize basic concept of phenomenon of light in various experiments

Core XV: Statistical Mechanics

- Understanding the concept of ensembles and its partition function, phase space and thermodynamic relations, MB distribution law.
- Conceptual understanding of addition of entropy, Sackur Tetrode equation, Law of equipartition of Energy and its application.
- Basic postulates and different distribution of Fermi and Dirac particles and B-E condensation.
- Basic knowledge in thermal and Black body radiation, Concept of different laws of radiation and their experimental verification.
- Apply the acquired knowledge for analyze the laws radiation and different distribution functions using computational analysis.