Department of Physics, Govt. Women's College, Balangir

PO1. Scientific Knowledge
Demonstrate knowledge of classical physics, modern physics, mathematics, and relevant interdisciplinary areas.

PO2. Problem Analysis
Identify physical problems, analyse them using scientific reasoning, and interpret solutions mathematically.

PO3. Experimental Skills
Perform laboratory experiments with accuracy, use instruments correctly, and analyse data scientifically.

PO4. Inquiry and Critical Thinking
Cultivate an investigative mind-set and critical thinking skills for identifying problems, reviewing literature, proposing hypotheses, and interpreting research outcomes.

PO5. Research Aptitude
Develop a scientific temper, curiosity, and research oriented attitude that enables students to formulate problems, design investigations, analyse data, and contribute to knowledge creation.

PO6. Modern Tools
Use modern scientific instruments, sensors, computers, simulation tools, and programming for physics applications.

PO7. Communication
Communicate scientific ideas effectively through presentations, reports, graphs, and digital tools.

PO8. Ethics
Demonstrate ethical behaviour, academic honesty, and responsibility in experimental and theoretical work.

PO9. Environment & Sustainability
Recognize the relevance of physics in energy, environment, and sustainable technology.

PO10. Teamwork
Work effectively as an individual and as a team member in laboratory or project settings.

PO11. Lifelong Learning
Engage in continuous learning and adapt to new scientific developments.

PO12. Application of Physics
Apply physics principles in solving real-world problems, technology development, and research.

SEMESTER-I

PAPER 1 MATHEMATICAL PHYSICS-I:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The main emphasis of this course is to equip the student with calculus and vector algebra.
PSO2. Vector differentiation & integration, as well as the applications of Gauss, Green and Stokes theorems.
PSO3. They will learn the properties and use of Dirac delta function. They will be familiar with representation of vector operations in different co-ordinate systems.
PSO4. Moreover, they will be able to write programming so solve a problem and can estimate the error.

COURSE OUTCOMES:

CO1. Apply calculus concepts, such as Taylor and binomial series and differential equations, to solve complex mathematical and physical problems
CO2. Perform vector algebra operations and interpret scalar and vector products in terms of areas, volumes, and other physical applications
CO3. Compute gradient, divergence, and curl of scalar and vector fields, and understand their significance in various geometrical and physical contexts and can do vector integration.
CO4. Understand orthogonal curvilinear coordinates and its application in different areas.
CO5. Understand the basic algorithm and application to functional algebra and error analysis.

PAPER 2 MECHANICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course aims to provide students with a comprehensive understanding of classical mechanics and special relativity, focusing on the fundamental concepts of rotational dynamics, oscillations, elasticity, fluid motion, gravitation, central force motion, relativistic mechanics and Doppler effect.
PSO2. They will get insights into non-inertial systems, the behaviour of bodies under the influence of forces, and the implications of relativistic effects.
PSO3. Students will develop problem-solving skills to analyze and interpret physical situations through mathematical formulations and physical laws.

COURSE OUTCOMES:

CO1. Comprehend the rotational dynamics, including angular momentum, moment of inertia and kinetic energy of rotation, and can apply systems having both translation and rotation.
CO2. Understand the behaviour of oscillatory systems, including damped and forced oscillation and analyze resonance phenomena, power dissipation and quality.
CO3. Describe the concepts of elasticity and fluid motion, and solve problems involving torque, bending of beams, viscosity, and surface tension in liquids.
CO4. Analyze gravitational forces and central force motion, solve two-body problems and apply Kepler's laws to planetary motion and satellite dynamics.
CO5. Grasp the postulates of special theory of relativity, meaning of Lorentz transformations and understand mass-energy equivalence and the relativistic Doppler effect.

MINOR-PAPER 1 MECHANICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course aims to provide students with a comprehensive understanding of classical mechanics and special relativity, focusing on the fundamental concepts of rotational dynamics, oscillations, elasticity, fluid motion, gravitation, central force motion, relativistic mechanics and Doppler effect.
PSO2. They will get insights into non-inertial systems, the behaviour of bodies under the influence of forces, and the implications of relativistic effects.
PSO3. Students will develop problem-solving skills to analyze and interpret physical situations through mathematical formulations and physical laws.

COURSE OUTCOMES:

CO1. Comprehend the rotational dynamics, including angular momentum, moment of inertia and kinetic energy of rotation, and can apply systems having both translation and rotation.
CO2. Understand the behaviour of oscillatory systems, including damped and forced oscillation and analyze resonance phenomena, power dissipation and quality.
CO3. Describe the concepts of elasticity and fluid motion, and solve problems involving torque, bending of beams, viscosity, and surface tension in liquids.
CO4. Analyze gravitational forces and central force motion, solve two-body problems and apply Kepler's laws to planetary motion and satellite dynamics.

CO5. Grasp the postulates of special theory of relativity, meaning of Lorentz transformations and understand mass-energy equivalence and the relativistic Doppler effect.

SEMESTER-II

PAPER3 ELECTRICITY AND MAGNETISM:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The course aims to equip students with a thorough understanding of electrostatics, magnetism, dielectrics and electrical circuits.
PSO2. By studying electric and magnetic fields, the behaviour of materials under the influence of electric and magnetic forces, and the principles governing AC and DC circuits, students. The way to simplify a complicated circuit with the use of different network theorems will be taught.
PSO3. This knowledge will form the foundation for further studies in electromagnetic theory and applications in various electrical systems.

COURSE OUTCOMES:

CO1. Understand the concepts of electric fields and potentials, apply Gauss's law to symmetrical charge distributions. To find out potentials for different shapes of conductors.
CO2. Know Lorentz force, Biot-Savart law, and Ampere's circuital law, to analyze magnetic fields produced by various current distributions and their applications.
CO3. Describe the dielectric and magnetic properties of matter and analyze ferromagnetism, hysteresis, and electromagnetic induction using Maxwell's equations
CO4. Apply network theorems to solve DC circuit problems, and analyze transient responses in RC and LR circuits involving current growth and decay.

PAPER4 MATHEMATICAL PHYSICS-II:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course introduces students to advanced mathematical techniques essential for solving problems.

PSO2. Through topics such as Fourier series, special functions, polynomials and partial differential equations, students will develop skills in analysing complex systems.
PSO3. The course emphasizes the application of these mathematical tools to various physical phenomena, including wave motion, heat conduction and electromagnetic fields.

COURSE OUTCOMES:

CO1. Understand Fourier series and can expand periodic and non-periodic functions.
CO2. Learn Frobenius method and solve special functions such as Bessel, Legendre, and Hermite polynomials. Students will know recurrence relations, orthogonality property, Rodrigues Formula and the Generating Function.
CO3. Know the Special functions such as Spherical Bessel functions, Beta, Gamma, and Error functions and their use.
CO4. Analyze and solve partial differential equations using separation of variables in problems with rectangular, cylindrical, and spherical symmetry.

SEMESTER-III

PAPER5 WAVE AND OPTICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course provides a detailed study of the fundamental concepts of optics, covering both geometrical and wave optics.
PSO2. Students will explore the principles governing the propagation, interference, and diffraction of light, as well as the behaviour of optical systems such as lenses and interferometers.
PSO3. Through a combination of theoretical analysis and practical applications, students will gain a deeper understanding of how light interacts with matter and how optical devices are designed and used.

COURSE OUTCOMES:

CO1. Apply the principles of geometrical optics, including Fermat's principle, matrix formulation, and cardinal points to analyze optical systems
CO2. Understand the electromagnetic properties of light and describe wave phenomena such as coherence and superposition in both plane and spherical waves.

CO3. Analyze interference phenomena using division of amplitude and wave front and will find the wave length of light and refractive indices using Newton's rings, Michelson and Fabry-Perot interferometers.
CO4. Explain Fraunhofer and Fresnel diffraction, including single and double slit diffraction, the resolving power of optical instruments and diffraction patterns for various apertures, zone plates and their use.

PAPER6 MATHEMATICAL PHYSICS–III:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course aims to introduce students to advanced mathematical techniques used in solving complex physical problems.
PSO2. Focusing on complex analysis and integral transforms, the course will explore essential mathematical tools such as Fourier and Laplace transforms, as well as the application of complex variable functions and residue theorem.
PSO3. Students will learn to apply these methods in solving differential equations and integrals.

COURSE OUTCOMES:

CO1. Understand the fundamentals of complex analysis, including complex numbers, Euler's formula, De Moivre's theorem, and apply these to solve problems involving complex variables, analyticity, singular functions, and contour integration.
CO2. Use Cauchy's integral formula, Taylor and Laurent expansions, and the residue theorem to evaluate complex integrals and solve real definite integrals.
CO3. Apply Fourier transforms to analyze trigonometric, Gaussian and wave functions and utilize these in solving differential equations such as wave and heat flow equations.
CO4. Apply Laplace transforms to solve differential equations, analyze simple electrical circuits and damped harmonic oscillators and apply properties to various fields.

PAPER7 THERMAL PHYSICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The primary aim of this course is to make the students understand thermodynamics and kinetic theory, emphasizing the fundamental principles governing energy, heat, and work in physicals systems and the different processes.

PSO2. Students will explore the laws of thermodynamics, entropy, thermodynamic potentials, phase transitions and the behaviour of real gases.

PSO3. The course will cover velocity distributions, molecular collisions and transport phenomena.

COURSE OUTCOMES:

CO1. Know the four laws of thermodynamics and analyze thermodynamic processes, the scales of temperatures, calculate entropy changes and understand the concept of absolute zero.

CO2. Utilize thermodynamic potentials: internal energy, enthalpy, Helmholtz and Gibbs free energy in solving problems involving surface tension, magnetic work and cooling due to adiabatic demagnetization.

CO3. Analyze first and second-order phase transitions, using Clausius-Clapeyron and Ehrenfest equations and apply Maxwell's thermodynamic relations to derive relation among thermodynamic variables

CO4. Understand the kinetic theory of gases, including the Maxwell-Boltzmann distribution of velocities, molecular collisions, mean free path, and transport phenomena such as viscosity, thermal conductivity, and diffusion.

CO5. Examine the behaviour of real gases, including deviations from the ideal gas law, the Virial equation, Van der Waals equation of state, and Joule-Thomson effect, and apply these concepts to understand real gas behaviour and experimental observations.

MINOR- PAPER2 ELECTRICITY AND MAGNETISM:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The course aims to equip students with a thorough understanding of electrostatics, magnetism, dielectrics and electrical circuits.

PSO2. By studying electric and magnetic fields, the behaviour of materials under the influence of electric and magnetic forces, and the principles governing AC and DC circuits, students. The way to simplify a complicated circuit with the use of different network theorems will be taught.

PSO3. This knowledge will form the foundation for further studies in electromagnetic theory and applications in various electrical systems.

COURSE OUTCOMES:

CO1. Understand the concepts of electric fields and potentials, apply Gauss's law to symmetrical charge distributions. To find out potentials for different shapes of conductors.
CO2. Know Lorentz force, Biot-Savart law, and Ampere's circuital law, to analyze magnetic fields produced by various current distributions and their applications.
CO3. Describe the dielectric and magnetic properties of matter and analyze ferromagnetism, hysteresis, and electromagnetic induction using Maxwell's equations
CO4. Apply network theorems to solve DC circuit problems, and analyze transient responses in RC and LR circuits involving current growth and decay.

MDC- PHYSICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course aims to provide Basic knowledge of Physics like Kirchhoff's laws, use of Wheatstone Bridge, N-type & P-Type Semiconductor, biasing a PN junction, transistors and their connections.
PSO2. Students will be able to do load line analysis of any transistors.

COURSE OUTCOMES:

CO1. Understand the basic idea of drift velocity and the origin of resistivity. They will be able to find out the unknown resistance using a wheatstone bridge and can understand the difference of cells connected in Series and in Parallel
CO2. Get ideas regarding majority and minority charge carriers and the effect of temperature on resistivity of a semiconductor.
CO3. Know the forward and reverse biasing and the operating conditions of junction diodes.
CO4. Solve problems on common transistor connections, their leakage currents and will understand different uses of semiconductor devices.

SEMESTER-IV

PAPER8 ANALOG SYSTEMS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course aims to provide students with a comprehensive understanding of the fundamental principles of semiconductor devices and their applications in electronic circuits.

PSO2. It introduces semiconductor diodes, bipolar junction transistors (BJTs), amplifiers, and operational amplifiers (Op-Amps).
PSO3. The course will explore the working mechanisms of diodes and transistors, analyze rectifiers, amplifiers, and oscillators, and cover the operation and design of different amplifier configurations.
PSO4. Additionally, students will learn about the practical applications of Op-Amps in various electronic systems.

COURSE OUTCOMES:

CO1. Explain the working principles and characteristics of semiconductor diodes, transistors and their applications in rectifiers, voltage regulation and amplification.
CO2. Analyze the operation of various transistor configurations (CB, CE, CC) and understand the current flow mechanisms, load line analysis and biasing techniques.
CO3. Classify and differentiate between Class A, B, and C amplifiers and evaluate the performance of RC-coupled amplifiers in terms of frequency response.
CO4. Understand the principles of feedback in amplifiers and design oscillators such as RC, phase shift, Hartley, and Colpitts oscillators based on the Barkhausen criterion.
CO5. Apply operational amplifiers (Op-Amps) in circuit designs for inverting/non-inverting amplifiers, adders, subtractors, differentiators, integrators, and oscillators.

PAPER9 BASIC INSTRUMENTATION:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The course aims to provide students with a thorough understanding of the principles and working of various electronic measuring instruments.
PSO2. Students will explore the concepts of accuracy, precision, and errors in measurement. The course covers the operational principles and block diagrams of key devices such as multimeters, oscilloscopes, signal generators and digital instruments.
PSO3. Students will gain practical knowledge of the construction, specifications and applications of these instruments, preparing them to apply this knowledge in real-world scenarios and laboratory environments.

COURSE OUTCOMES:

CO1. Understand and differentiate between various measurement parameters such as accuracy, precision, sensitivity and resolution and analyze the sources of errors in measurements.
CO2. Explain the working principles and significance of different types of multimeters (analog and digital) for measuring voltage, current, and resistance, along with their specifications.
CO3. Describe the construction and operation of Cathode Ray Oscilloscopes (CROs), including their applications in measuring voltage, current, frequency, and phase difference.
CO4. Interpret the block diagrams and working principles of signal generators including low-frequency signal generators, pulse generators and distortion factor meters.
CO5. Compare digital and analog instruments and explain the working of digital multimeters, voltmeters, and frequency counters, with an understanding of time-base stability, accuracy, and resolution.

PAPER10 NUCLEAR AND PARTICLE PHYSICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course aims to provide students with a comprehensive understanding of atomic and nuclear physics, focusing on the behaviour of atoms in electric and magnetic fields, the structure and forces within the atomic nucleus, and various nuclear models.
PSO2. Students will explore key phenomena like the Zeeman Effect, nuclear stability, radioactive decay, and nuclear reactions, as well as delve into the fascinating world of particle physics, including the classification of particles and fundamental forces.
PSO3. The course also introduces advanced concepts such as the Higgs boson, dark matter, and energy, providing a broad overview of both established theories and cutting-edge discoveries in modern physics.

COURSE OUTCOMES:

CO1. Analyze the behaviour of atoms in external electric and magnetic fields and explain the Zeeman and Stark effects.
CO2. Describe the structure and properties of the atomic nucleus, including nuclear forces, nuclear stability and energy production.
CO3. Explain the mechanisms of radioactive decay and the applications of radioisotopes in various fields.

CO4. Apply nuclear models like the liquid drop and shell models to explain nuclear behaviour and reactions, including fission and fusion.
CO5. Understand the classification of subatomic particles, conservation laws and the significance of quarks and the Higgs boson in particle physics.

SEMESTER-V

PAPER11 DIGITAL SYSTEMS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course introduces students to the fundamentals of integrated circuits, digital electronics, and computer organization.
PSO2. Covering the principles of analog and digital circuits, Boolean algebra, data processing circuits, and basic components of computer systems, the course provides students with a foundational understanding of how digital systems are designed, analyzed, and implemented.
PSO3. The course also includes practical applications of various components and circuits used in modern electronic systems.

COURSE OUTCOMES:

CO1. Understand IC's, there scales of Integration and its drawbacks.
CO2. Interconvert among binary, decimal, octal, and hexadecimal number systems and implement basic digital logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR) using diodes and transistors.
CO3. Apply Boolean algebra and De Morgan's theorems to simplify logic circuits, use Karnaugh maps for SOP and POS simplification, and implement universal logic functions using the universal gates -NAND and NOR gates.
CO4. Design basic data processing circuits including multiplexers, de-multiplexers, decoders, and encoders, and arithmetic circuits such as binary adders, subtractors, and 4-bit binary adder/subtractors.
CO5. Understand the organization of computers, including input/output devices, data storage, memory organization and interfacing and design shift registers and counters

PAPER12 QUANTUM MECHANICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The objective of this course is to provide students with a foundational understanding of quantum mechanics, focusing on the formulation and solutions

of the Schrödinger equation, both timedependent and time-independent, in one, two, and three dimensions.
PSO2. Students will gain a comprehensive understanding of wave functions, probability densities, and operators, as well as the significance of igenvalues and eigenfunctions.
PSO3. The course will introduce key quantum phenomena such as wave-particle duality, uncertainty relations, and quantum tunneling, with practical applications to one-dimensional quantum systems, including quantum dots, harmonic oscillators, and potential barriers.
PSO4. Through this, students will develop a deeper understanding of quantum mechanics' theoretical framework and its physical implications.

COURSE OUTCOMES:

CO1. 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.
CO2. Explain Time independent Schrödinger equation, Eigenvalue, Eigenfunction, generalized solution of stationary states, knowledge in wave function and discrete energy level.
CO3. Basic knowledge in quantum mechanical operators, Eigen value and Eigen function, Uncertainty relation and Gaussian wave packet.
CO4. Acquire the knowledge in application of Schrödinger equation in different potential barriers, concept of simple harmonic oscillator.
CO5. Apply the acquired knowledge to solve various numerical problems.

PAPER13 SOLID STATE PHYSICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. This course provides an in-depth exploration of solid-state physics, focusing on the fundamental concepts of crystal structure, lattice dynamics and electronic band theory.
PSO2. Students will know Xray diffraction and Braggs law, Lattice with different basis, unit cell and reciprocal lattice.
PSO3. They will explore about phonon, specific heats of solids, Kroning-Penny model, semiconductors, Hall effect and dvanced topics such as lasers and superconductivity.

COURSE OUTCOMES:

CO1. Understand the Concept of crystal structure, miller indices, X-ray Diffraction, Bragg's and Laue's condition, Reciprocal Lattice, Brillouin zones etc.
CO2. Explain Lattice vibration, Einstein and Debye specific heat theories of solids, describe the behaviour of conductors, semiconductors, and insulators,
CO3. Analyze the magnetic and dielectric properties of materials, employing classical theories to explain phenomena such as ferromagnetism, Curie's law, and electrical polarization.
CO4. Comprehend and differentiate laser operations and principles of stimulated emission and evaluate the functioning of various laser systems, including Ruby and He-Ne lasers.
CO5. Explore and explain superconductivity concepts, such as the Meissner effect, type-I and type-II superconductors, the basics of the BCS theory and the London's Equation

MINOR- PAPER3 THERMAL PHYSICS:

PROGRAM SPECIFIC OUTCOMES:

PSO1. The primary aim of this course is to make the students understand thermodynamics and kinetic theory, emphasizing the fundamental principles governing energy, heat, and work in physicals systems and the different processes.
PSO2. Students will explore the laws of thermodynamics, entropy, thermodynamic potentials, phase transitions and the behaviour of real gases.
PSO3. The course will cover velocity distributions, molecular collisions and transport phenomena.

COURSE OUTCOMES:

CO1. Know the four laws of thermodynamics and analyze thermodynamic processes, the scales of temperatures, calculate entropy changes and understand the concept of absolute zero.
CO2. Utilize thermodynamic potentials: internal energy, enthalpy, Helmholtz and Gibbs free energy in solving problems involving surface tension, magnetic work and cooling due to adiabatic demagnetization.
CO3. Analyze first and second-order phase transitions, using Clausius-Clapeyron and Ehrenfest equations and apply Maxwell's thermodynamic relations to derive relation among thermodynamic variables

CO4. Understand the kinetic theory of gases, including the Maxwell-Boltzmann distribution of velocities, molecular collisions, mean free path, and transport phenomena such as viscosity, thermal conductivity, and diffusion.
CO5. Examine the behaviour of real gases, including deviations from the ideal gas law, the Virial equation, Van der Waals equation of state, and Joule-Thomson effect, and apply these concepts to understand real gas behaviour and experimental observations.

SEMESTER-VI

PAPER 14 ELECTROMAGNETIC THEORY:

PROGRAM SPECIFIC OUTCOMES:

PSO4. The objective of an Electromagnetic Theory course is to provide students with a comprehensive understanding of the fundamental principles governing electric and magnetic fields and their interactions.
PSO5. This course typically covers topics such as Maxwell's equations, electromagnetic wave propagation and the behaviour of fields in various media.
PSO6. By integrating theoretical concepts with practical applications, students are expected to develop the analytical skills necessary to solve complex problems in electromagnetics.

COURSE OUTCOMES:

CO1. Understand physical significance of Maxwell Equations and their applications to different media, Lorentz and Coulomb gauge, pointing theorem, concept of energy density.
CO2. Understand relaxation time, skin depth, Electrical conductivity of ionized gases, plasma frequency and propagation of EM wave through ionosphere
CO3. Know the polarization of EM wave, construction and use of Nicol Prism, the Laurents half-shade polarimeter to find specific rotation.
CO4. Understand Babinets Compensator, Brewster’s law and verify in the laboratory.

PAPER15 STATISTICAL MECHANICS: Credit-3

PROGRAM SPECIFIC OUTCOMES:

PSO1. The main motive of a Statistical Physics course is to equip students with a deep understanding of the principles and methods used to analyse and predict the behaviour of large systems composed of many particles.

PSO2. This course typically explores topics such as probability theory, thermodynamics and statistical ensembles, emphasizing how microscopic interactions lead to macroscopic phenomena like temperature, pressure and entropy.

PSO3. Through this framework, students learn to connect microscopic properties with observable macroscopic properties, which is essential for advancing in fields such as material science, nuclear physics, chemistry, condensed matter physics etc.

COURSE OUTCOMES

CO1. Understand the concept of ensembles and its partition function, phase space and thermodynamic relations, MB distribution law.

CO2. Addition of entropy & Sackur Tetrode equation, Law of equipartition of Energy and its application. Basic postulates and different distributions for Fermi and Dirac particles and the B-E condensation.

CO3. Know Blackbody radiation, Concept of different laws of radiation and their experimental verification.

CO4. Apply the acquired knowledge for analyse the laws radiation and different distribution functions using computational analysis