GOVERNMENT GENERAL DEGREE COLLEGE AT PEDONG
Affiliated to University of North Bengal
PEDONG, KALIMPONG - 734311
Email: physics.ggdcpedong@gmail.com
सत्यमेव जयते
DEPARTMENT OF PHYSICS

Programme Outcome

Programme Outcome Nos	Programme Outcome
PO 1	This course enables students to review fundamental principles of physics. They will possess the ability to utilize their understanding of fundamental scientific principles to solve complex challenges of scientific and technical significance.
PO 2	This course enables students to analyze complex scientific problems utilizing computational skills.
PO 3	This course enables students to employ scientific methodologies, establish principles, and resolve issues related to applied science.
PO 4	This course enables students to utilize suitable methodologies, advanced technological resources, and IT tools to predict and simulate scientific challenges.
PO 5	This course enables students to develop a solid knowledge base that they can apply in doing research for the betterment of society in the near future.

Attainment of POs of B. Sc. Physics (Honours)

PO 1	✓
PO 2	✓
PO 3	✓
PO 4	✓
PO 5	✓

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE OUTCOME – UNDERGRADUATE PHYSICS HONOURS (CBCS SYSTEM)

SEMESTER-I

NAME OF THE PROGRAMME: B. Sc. **YEAR OF INTRODUCTION: 2018**

COURSE: CC1 [Mathematical Physics-I] (FM 40)

COURSE NAME: Calculus, Vector calculus, Orthogonal curvilinear coordinates, Introduction to probability, Dirac delta functions and its properties.

COURSE OUTCOME: It gives them the chance to learn both the basics of regular calculus analysis and vector calculus. Students are also taught about different coordinate systems and how they can be used in physics. They are also taught about the idea of probability in physics. They will also learn about the Dirac delta function and the different things that make it work.

COURSE: CC1 [Mathematical Physics-I] PRACTICAL (FM 20)

COURSE NAME: Mathematical Physics I LAB

COURSE OUT COME: Students are introduced to a variety of programming languages, such as Python, C, C++, and so on. They will become familiar to using programming languages to solve any problems in math associated with physics.

COURSE: CC 2 [Mechanics] (FM 40)

COURSE NAME: Fundamental of Dynamics, Work and energy, Collisions, Rotational Dynamics, Elasticity, Fluid motion, Gravitational and Central Force motion, Oscillations, Non-inertial systems, Special theory of Relativity

COURSE OUT COME: Students will learn about the fundamental concepts of dynamic systems. They will understand the elasticity of matter and the gravitational field. In order to provide solid foundations for research-based physics courses, students are also introduced to the fundamentals of special theory of relativity.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE: CC1 [Mechanics] PRACTICAL (FM 20)

COURSE NAME: Mechanics I LAB

COURSE OUT COME: The students will be given practical instruction in the determination of the gravitational constant, calculation of moment of inertia, various measurement techniques, evaluation of elastic modulus, and viscosity of liquids.

COURSE: GE 1A [Mechanics] (FM 40)

COURSE NAME: Vectors, Ordinary differential equations, laws of motion, momentum and energy, Rotational motion, Gravitation, Oscillations, Elasticity, Special theory of relativity

COURSE OUT COME: The students are introduced to the fundamentals of vectors and differential equations. In addition, they will acquire knowledge of many aspects of dynamical systems, gravitation, and relativity.

COURSE: GE 1A [Mechanics] PRACTICAL (FM 20)

COURSE NAME: Mechanics I LAB

COURSE OUT COME: Students will gain knowledge of several measuring techniques and use them to assess the gravitational constant and elastic modulus through a variety of practical exercises.

COURSE: GE1B [Thermal Physics and Statistical Mechanics] (FM 40)

COURSE NAME: **UNIT 1:** Law of thermodynamics**, UNIT 2:** Thermodynamical Potentials, **UNIT 3:** Kinetic Theory of gases, **UNIT 4:** Theory of radiation, **UNIT 5:** Statistical Mechanics

COURSE OUT COME: **Unit 1:** This unit will cover the thermodynamic description of a system. The users will gain knowledge about several principles of thermodynamics, including the Zeroth Law, First Law, Second Law, and Third Law. The general relationship between specific heat at constant pressure (C_P) and specific heat at constant volume (C_V). The topics covered include the work done in isothermal and adiabatic processes, reversible and irreversible processes, entropy, Carnot's cycle, and Carnot's theorem.

Unit 2: This unit will cover the concepts of Enthalpy, Gibbs, Helmholtz, and Internal Energy functions, as well as Maxwell's relations and their applications. The topics to be discussed include the Joule-Thompson Effect, Clausius-Clapeyron Equation, expressions for (C_P - C_V), C_P/C_V, and TdS equations.

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

Unit 3: This unit will cover the derivation of Maxwell's law of velocity distribution, the concept of mean free path, and the study of transport phenomena including viscosity, conduction, and diffusion. Additionally, it will explore the law of equipartition of energy and its practical applications.

Unit 4: In this section, students will get a comprehensive understanding of the theory of radiation. They will explore several concepts like Blackbody radiation, Planck's law, Wien's distribution law, Rayleigh-Jeans Law, Stefan-Boltzmann Law, and Wien's displacement law derived from Planck's law.

Unit 5: In this unit the students will learn need and elements of statistical mechanics. In statistical mechanics students will be enriched by concept of phase-space, microstate and macro state. They will also learn the topics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications.

COURSE: GE1B [Thermal Physics and Statistical Mechanics] PRACTICAL (FM 20)

COURSE NAME: Thermal Physics and Statistical Mechanics Lab

COURSE OUT COME: The students will learn practical applications of thermal physics and statistical mechanics, such as determining the Mechanical Equivalent of Heat (J) using Callender and Barne's method, calculating Planck's constant through black body radiation, determining Stefan's Constant, measuring the coefficient of thermal conductivity of Cu using Searle's Apparatus and Angstrom's Method, calculating the coefficient of thermal conductivity using Lee and Charlton's method, determining the temperature co-efficient of resistance using a Platinum resistance thermometer, studying the variation of thermo emf across two junctions of a thermocouple with temperature, recording and analyzing temperature using a thermocouple, and calibrating a Resistance Temperature Device (RTD).

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

SEMESTER-II

COURSE: CC3 [Electricity and Magnetism] (FM 40)

COURSE NAME: Electric Field and Electric potential, Dielectric Properties of Matter, Magnetic Field, Magnetic Properties of Matter, Electromagnetic Induction, Electrical Circuits and Network theorems.

COURSE OUT COME: The fundamental principles of electric field and dielectric media are presented to the students. Additionally, they will get knowledge on the basic principles of magnetostatics and electromagnetic induction. This section also presents many methods of analyzing electrical circuits to address complicated electrical issues.

COURSE: CC3 [Electricity and Magnetism] PRACTICAL (FM 20)

COURSE NAME: Electricity and Magnetism Lab

COURSE OUT COME: This course introduces practical training on the implementation of passive and active components in electrical circuits. The students will also acquire the ability to study several approaches for evaluating the values of unknown resistance, inductance, and capacitance.

COURSE: CC4 [Waves and Optics] (FM 40)

COURSE NAME: Superposition of collinear harmonic oscillations, superposition of two perpendicular harmonic oscillations, wave motion, velocity of waves, superposition of two harmonic waves, waves optics, interference, interferometer, diffraction and holography.

COURSE OUT COME: This text introduces the ideas of waves and their superposition. Students will acquire knowledge of the wave properties of light through the study of interference and diffraction occurrences. This work also introduces the concepts of interferometer and holography.

COURSE: CC4 [Waves and Optics] PRACTICAL (FM 20)

COURSE NAME: Waves and Optics Lab

COURSE OUT COME: Students will be able to realize the different properties of light via the interference, diffraction based experiments.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE: GE 2A [Electricity and Magnetism] (FM 40)

COURSE NAME: Vector analysis, Electrostatics, Magnetism, Electromagnetic induction, Maxwell's equations and electromagnetic wave propagation.

COURSE OUT COME: Students will learn about the vectors, electrostatics and magnetostatics. They will also learn about the electromagnetic inductions and wave nature of the electromagnetic fields.

COURSE: GE 2A [Electricity and Magnetism] PRACTICAL (FM 20)

COURSE NAME: Electricity and Magnetism lab

COURSE OUT COME: Students will learn about the vectors, electrostatics and magnetostatics. They will also learn about the electromagnetic inductions and wave nature of the electromagnetic fields.

COURSE: GE 2B [Waves and Optics] (FM 40)

COURSE NAME: **Unit 1:** Superposition of two Collinear Harmonic Oscillations, **Unit 2:** Superposition of two Perpendicular Harmonic Oscillations, **Unit 3:** Wave Motion –General, **Unit 4:** Sound, **Unit 5:** Wave Optics, **Unit 6:** Interference of light, **Unit 7:** Michelson's Interferometer, Unit 8: Diffraction of light, **Unit 9:** Polarization of light

COURSE OUT COME: **Unit 1:** Students will be instructed on the concepts of Linearity and Superposition Principle as they apply to two oscillations with identical frequencies. In addition, they will get knowledge regarding the linearity and superposition of two oscillations with distinct frequencies, which consequently leads to the production of beats. Additionally, students will possess the ability to successfully answer both conceptual and numerical issues related to these subjects.

Unit 2: This segment will provide students with an understanding of the graphical and analytical method for superimposing two perpendicular oscillations of the same or different frequency. It will also cover the construction of Lissajous figures. The students will meticulously examine the patterns of Lissajous figures and thereafter render them with precision.

Unit 3: Students will get an understanding of the production of transverse waves, travelling waves, and standing waves on a string. The students will acquire knowledge about many characteristics of transverse waves, including travelling waves and standing waves on a string. They will also apply this knowledge to

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

solve numerical problems related to these topics. The students will have the capacity to mathematically represent various forms of waves using appropriate sinusoidal periodic functions. The user will acquire knowledge on the normal modes of vibrations exhibited by a string. They will acquire an understanding of phase velocity and group velocity and will be capable of establishing a mathematical relationship between the two. The pupils will also be instructed on the concepts of Plane waves, Spherical waves, and Wave intensity.

Unit 4: This section of the course will cover topics such as simple harmonic motion, damped vibration, forced vibration, and resonance. Students will acquire the ability to distinguish between Velocity resonance and Amplitude resonance, to graph the resonance curve, and to calculate resonant frequencies, half power frequencies, and bandwidth. They will get understanding of the sharpness of resonance and the quality component of resonance. Students will examine Fourier's theorem and utilize it to analyze Saw-tooth and Square waves. Students will acquire knowledge of units such as decibel and phon, which measure the relative strength and loudness of sound, respectively. Students will gain insight into musical notes and musical scales. In addition, they will receive instruction on the topic of building acoustics. In this context, students will receive instruction on issues such as Reverberation, Reverberation time, and Absorption coefficient. Students will calculate the Sabine's formula. They will possess the capability to compute the reverberation time and comprehend the various acoustic characteristics of halls and auditoriums. This will assist students in the process of designing the inside of a hall and auditorium.

Unit 5: The students in this section will learn about electromagnetic nature of light as a consequence of Maxwell's equations in Electromagnetism. They will get a very clear idea of wave front and will be able to distinguish between plane wave front, Spherical wave front and Cylindrical wave front. The students will learn the Huygens Principle and will be able to explain the propagation of light wave.

Unit 6: At first the students will learn about the Young's double slits experiments and the formation of interference fringes. Then they will be able to state the definition of interference. Students will be able to classify the two methods of interference i.e. Division of amplitude and division of wave front. Students will be familiar with the different techniques for production of interference like Fresnel's bi prism method, Lloyd's single mirror method, Newton's rings formation. The students will find the expression of diameter of Newton's rings. By using this expression students will measure the diameter and they will be able to determine the unknown wave length of monochromatic light and the refractive index of liquid. Students will get idea about the fringes of equal inclination and fringes of equal thickness also. Students will also solve a lot of numerical problems.

Unit 7: This section will provide students with an understanding of the many forms or shapes of interference fringes that are created by the Michelson interferometer. Students will acquire knowledge about the construction and operational principles of the Michelson interferometer in a concise manner. Students will be taught the techniques for determining the unknown wavelength of monochromatic light, the difference in wavelengths of a compound light with two wavelengths, and the refractive index of a thin transparent film and its thickness using Michelson's interferometer.

Unit 8: Initially, the students will learn the detailed description of light diffraction and the exact prerequisites that must be met for light diffraction to take place. Students will acquire the ability to distinguish between the two distinct categories of diffraction, namely Fraunhofer diffraction and Fresnel diffraction. The category of Fraunhofer diffraction covers the study of light diffraction through many types of slits, including single, double, and multiple slits, as well as diffraction gratings. Students will learn about the mathematical equations that describe the intensities of the diffraction patterns in each of these cases. Within the realm of Fresnel Diffraction, students will acquire knowledge pertaining to the concepts of half period zones and zone plates. Students can utilize the concept of half period zones to elucidate either the bending, also known as diffraction, of light or the straight-line propagation of light.

Unit 9: In this unit students will learn about the transverse nature of light waves. Then students will understand the mutual orthogonal directions of Electric field, Magnetic field and Propagation of light wave very well. After this the students will learn about the meaning of plane polarized light and methods of production and analysis of this plane polarized light. At last students will get an elementary idea about the circularly polarized light and the elliptically polarized light too.

COURSE: GE 2B [Waves and Optics] PRACTICAL (FM 20)

COURSE NAME: Waves and Optics Lab

COURSE OUT COME: During the practical session,

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

(i) Students will explore the movement of interconnected oscillators and determine the usual modes of vibrations.
ii) The objective is to determine the frequency of an electrically sustained tuning fork using Melde's experiment and to validate the relationship between wavelength and tension.
iii) The objective is to examine the Lissajous figure using a Cathode Ray Oscilloscope and to graph the waveforms of the individual waves and the combined wave, and then compare them to the theoretical understanding of Lissajous figure generation.
iv) Calculate the coefficient of viscosity of water using the capillary flow method, also known as Poiseuille's method.
v) Utilize an optical bench, photo sensor, and laser to quantify the intensities of diffraction patterns produced by a single slit and double slits. Additionally, ascertain the wavelength of the laser.
(vi) Calculate the wavelength of sodium light that is not known by measuring the diameters of Newton's rings using a traveling microscope.
(vii) Use a Fresnel biprism to determine the wavelength of monochromatic light that is currently unknown.
(viii) Ensure correct leveling of the spectrometer. Next, the spectrometer will be adjusted to align the incident rays and emergent rays in parallel using Schuster's focusing approach. Using the spectrometer, students will measure the refracting angle of the prism, determine the refractive indices of the prism's material for different colors of light with specific wavelengths, calculate the values of Cauchy constants, determine the dispersive power of the prism's material, calculate the resolving power of the prism, and find the unknown wavelengths of lights of different colors using a plane diffraction grating and its resolving power.

SEMESTER-III

COURSE: CC5 [MATHEMATICAL PHYSICS II] (FM 40)

COURSE NAME: **UNIT 1:** Fourier Series, **UNIT 2:** Frobenius Method and Special Functions, **UNIT 3:** Some Special Integrals, **UNIT 4:** Variational calculus in physics, **UNIT 5:** Partial Differential Equations.

COURSE OUT COME: **UNIT 1:** This course focuses on teaching students about the Fourier series expansion of periodic functions based on Dirichlet conditions. The main objective is to help students determine the correct Fourier coefficients. This will, in turn, assist pupils in determining the total of an infinite series. This section will cover the concepts of differentiating and integrating Fourier Series, as well as its complex representation. In addition, the students will also get knowledge of the Fourier expansion of non-periodic functions.

UNIT 2: This unit focuses on teaching students how to solve second-order linear ordinary differential equations (ODEs), specifically those with singular points. The unit also covers important second-order linear ODEs in Physics, such as Legendre and Bessel differential equations. Lastly, students will study the properties of Legendre polynomials and Bessel functions in detail.

UNIT 3: This section will introduce several crucial functions in Physics, such as Beta, Gamma, and Error functions. Students will gain knowledge about the various properties and uses of these functions.

UNIT 4: Students in this module will master a fundamental aspect of classical physics, specifically the Lagrangian and Hamiltonian formulations of classical mechanics, which are based on variational calculus.

UNIT 5: This section focuses on teaching students how to solve significant partial differential equations that arise in Physics, such as Laplace's equation, the wave equation, and the diffusion equation. The method of separation of variables will be employed in various coordinate systems.

COURSE: CC5 [MATHEMATICAL PHYSICS II] PRACTICAL (FM 20)

COURSE NAME: Mathematical Physics II Lab

COURSE OUT COME: This course will teach students higher level programming using Python. They will acquire the skills to assess Gaussian integration, calculate numerical solutions for first and second order ordinary differential equations, and evaluate Fourier coefficients for a given periodic signal. This course aims to equip students with the necessary knowledge and skills to pursue advanced study and research in the fields of theoretical and computational physics.

COURSE: CC6 [Thermal Physics] (FM 40)

COURSE NAME: Introduction to thermodynamics, thermodynamic potentials, Maxwell's thermodynamic relations, Kinetic theory of gases.

COURSE OUT COME: Students will acquire fundamental knowledge in thermodynamics. The significance of several thermodynamic potentials will be demonstrated among them. In addition, they will get knowledge about the kinematics of the gas molecules.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE: CC6 [Thermal Physics] PRACTICAL (FM 20)

COURSE NAME: Thermal Physics Lab.

COURSE OUT COME: The students conduct experiments to observe various properties of thermal physics. They will acquire the ability to assess temperature and thermal conductivity through physical experiments.

COURSE: CC7 [Digital Systems and Applications] (FM 40)

COURSE NAME: Integrated circuits, digital circuits, Boolean algebra, data processing circuits, circuits, timers, shift registers, counters, computer organization.

COURSE OUT COME: The students will get knowledge on the basic principles and concepts of digital electronics. This resource provides an introduction to a variety of counter, timer, and data storage components for students. In addition, they will acquire knowledge regarding the structure and arrangement of computer systems

COURSE: CC7 [Digital Systems and Applications] PRACTICAL (FM 20)

COURSE NAME: Digital Systems and Applications lab.

COURSE OUT COME: Various counter, flip flop storage elements, logic gates is introduced among the students via physical experiments.

COURSE: SEC 1A [Computational Physics] (FM 60)

COURSE NAME: **Unit 1:** Introduction, **Unit 2:** Scientific Programming, **Unit 3:** Control Statements, **Unit 4:** Scientific word processing: Introduction to LaTeX, **Unit 5:** Visualization

COURSE OUT COME: **Unit 1:** In the introductory part of this skill enhancement course the students will learn the basic concepts of algorithm and flowchart with some basic examples of matrices, series sums etc.

Unit 2: In this section of the course, the students will receive a concise introduction to Linux. Following that, they will be introduced to FORTRAN, where they will acquire knowledge about many aspects of this programming language. The students will also acquire the expertise to compose a Fortran program aimed at resolving fundamental Physics problems.

Unit 3: In this section the students will learn different looping, control and jumping statements in FORTRAN. They will also get the concepts of function, array, sub-routine and file handling. Physical problem solving in this part will also be taught to them.

Unit 4: This section of the course will provide students with exposure to various LaTeX commands used for scientific data processing. This will be highly advantageous for them in terms of their future research career in Physics.

Unit 5: This section will provide students with knowledge about GUNPLOT, a tool specifically designed for handling data, particularly for manipulating graphical data. This will once again prove highly beneficial for them in their laboratory-based research.

COURSE: SEC 1B [Electrical Circuits and Networks Skills] (FM 60)

COURSE NAME: **Unit 1:** Basic Electricity Principles**, Unit 2:** Understanding Electrical Circuits, **Unit 3:** Electrical Drawing and Symbols, **Unit 4:** Generators and Transformers, **Unit 5:** Electric Motors, **Unit 6:** Solid-State Devices, **Unit 7:** Electrical Protection, **Unit 8:** Electrical Wiring

COURSE OUT COME: **Unit 1:** The initial segment of this skill augmentation course will cover the fundamental principles of Voltage, Current, Resistance, and Power. Ohm's law. Combinations of series, parallel, and series-parallel circuits. Alternating Current (AC) and Direct Current (DC) are two types of electricity. Being introduced with multimeter, voltmeter, and ammeter.

Unit 2: Students will get a concise understanding of the primary components of electric circuits, as well as the ways in which single-phase and three-phase alternating current sources can be combined. The AC system consists of real, imaginary, and complicated power components. These components are influenced by factors such as the power source, power factor, and the potential for energy and cost savings.

Unit 3: In this section the students will learn different drawing symbols, Blueprints, Ladder diagrams, Electrical Schematics, Power circuits, Tracking the connections of elements and identify current flow and voltage drop.

Unit 4: This part of the course will help the students to get the taste of DC Power sources, AC/DC generators, Operation of transformers.

Unit 5: This section will provide students with information on single-phase, three-phase, and DC motors. Connecting DC or AC power sources to regulate the operation of heaters and motors. The velocity and strength of an alternating current motor.

Unit 6: In this section the students will learn Diode and rectifiers. Components in Series or in shunt. Response of inductors and capacitors with DC or AC sources.

Unit 7: This part will provide students with knowledge on relays, fuses, disconnect switches, circuit breakers, grounding and isolating, and surge protection. Connecting direct current (DC) or alternating current (AC) sources to control elements.

Unit 8: This section will cover several types of conductors and cables that students will learn about. Fundamentals of electrical wiring: Star and delta connections. Electrical resistance and power dissipation in cables and conductors result in voltage drop and energy losses.

COURSE: GE 3A [Mechanics] (FM 40)

COURSE NAME: Vectors, Ordinary differential equations, laws of motion, momentum and energy, Rotational motion, Gravitation, Oscillations, Elasticity, Special theory of relativity

COURSE OUT COME: The students are introduced to the fundamentals of vectors and differential equations. In addition, they will acquire knowledge of many aspects of dynamical systems, gravitation, and relativity.

COURSE: GE 3A [Mechanics] PRACTICAL (FM 20)

COURSE NAME: Mechanics I LAB

COURSE OUT COME: Students will gain knowledge of several measuring techniques and use them to assess the gravitational constant and elastic modulus through a variety of practical exercises.

COURSE: GE 3B [Thermal Physics and Statistical Mechanics] (FM 40)

COURSE NAME: **UNIT 1:** Law of thermodynamics**, UNIT 2:** Thermodynamical Potentials, **UNIT 3:** Kinetic Theory of gases, **UNIT 4:** Theory of radiation, **UNIT 5:** Statistical Mechanics

COURSE OUT COME: **Unit 1:** This unit will cover the thermodynamic description of a system. The users will gain knowledge about several principles of thermodynamics, including the Zeroth Law, First Law, Second Law, and Third Law. The general relationship between specific heat at constant pressure (C_P) and specific heat at constant volume (C_V). The topics covered include the work done in isothermal and adiabatic processes, reversible and irreversible processes, entropy, Carnot's cycle, and Carnot's theorem.

Unit 2: This unit will cover the concepts of Enthalpy, Gibbs, Helmholtz, and Internal Energy functions, as well as Maxwell's relations and their applications. The topics to be discussed include the Joule-Thompson Effect, Clausius-Clapeyron Equation, expressions for (C_P - C_V), C_P/C_V, and TdS equations.

Unit 3: This unit will cover the derivation of Maxwell's law of velocity distribution, the concept of mean free path, and the study of transport phenomena including viscosity, conduction, and diffusion. Additionally, it will explore the law of equipartition of energy and its practical applications.

Unit 4: In this section, students will get a comprehensive understanding of the theory of radiation. They will explore several concepts like Blackbody radiation, Planck's law, Wien's distribution law, Rayleigh-Jeans Law, Stefan-Boltzmann Law, and Wien's displacement law derived from Planck's law.

Unit 5: In this unit the students will learn need and elements of statistical mechanics. In statistical mechanics students will be enriched by concept of phase-space, microstate and macro state. They will also learn the topics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distributions and their applications.

COURSE: GE 3B [Thermal Physics and Statistical Mechanics] PRACTICAL (FM 20)

COURSE NAME: Thermal Physics and Statistical Mechanics Lab

COURSE OUT COME: The students will learn practical applications of thermal physics and statistical mechanics, such as determining the Mechanical Equivalent of Heat (J) using Callender and Barne's method, calculating Planck's constant through black body radiation, determining Stefan's Constant, measuring the coefficient of thermal conductivity of Cu using Searle's Apparatus and Angstrom's Method, calculating the coefficient of thermal conductivity using Lee and Charlton's method, determining the temperature co-efficient of resistance using a Platinum resistance thermometer, studying the variation of thermo emf across two junctions of a thermocouple with temperature, recording and analyzing temperature using a thermocouple, and calibrating a Resistance Temperature Device (RTD).

SEMESTER IV

COURSE: CC8 [MATHEMATICAL PHYSICS III] (FM 40)

COURSE NAME: Complex analysis, Integrals transforms, Matrices, Eigen-values and Eigenvectors.

COURSE OUT COME: Students will get comprehensive knowledge of intricate complex analysis and its practical applications in diverse physical issues. Students are exposed to the significance of matrices and eigenvectors.

COURSE: CC8 [MATHEMATICAL PHYSICS III] PRACTICAL (FM 20)

COURSE NAME: Mathematical Physics III Lab

COURSE OUT COME: Detailed computational programming is introduced among the students to solve complex physical problems. They will learn to use matrices, complex integrations in computational problems.

COURSE: CC9 [ELEMENTS OF MODERN PHYSICS] (FM 40)

COURSE NAME: **UNIT 1:** Quantum nature of light: Planck's law, Photoelectric effect, Compton scattering, Matter wave, De Broglie's hypothesis, Davisson – Germer Experiment, Wave description of particles by wave packets, Two-slits experiment with electrons.

UNIT 2: Position measurement, Gamma ray microscope thought experiment, Heisenberg Uncertainty principle and various applications of this principle. Two slits interference experiments with photons, atoms and particles, linear superposition principle as a consequence, Matter waves and wave amplitude, Schrodinger equation for non-relativistic particles, Momentum and Energy operators, Stationary states, Physical interpretation of Wave function, position probability, normalization of a wave-function and probability current densities in one dimension.

UNIT 3: One dimensional infinitely rigid box-energy eigen values and eigen functions, Quantum dot as an example, Quantum mechanical scattering and tunneling in one dimension across a step potential barrier.
Size and structure of atomic nucleus and its relation with atomic weight. Impossibility of an electron being in nucleus as a consequence of Heisenberg's uncertainty principle. Nature of nuclear force ,NZ graph, Liquid drop model,

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

Semi-empirical mass formula and binding energy of nucleus, Nuclear shell model and magic numbers.

UNIT 4: Radioactive decay laws, Fission and fusion, Lasers

COURSE OUT COME:

UNIT 1: This section will cover the concepts of Planck's law and the quantum nature of light.Studying the concepts of Photoelectric effect and Compton scattering will enable pupils to grasp the true quantum nature of light. Additionally, students will acquire knowledge regarding the wave characteristics of particle motion, such as electrons, through the study of Matter waves and De Broglie's hypothesis. Students will get knowledge regarding various characteristics of matter waves. Familiarity with the Davison-Germer experiment and the Two-slit experiment using electrons will aid students in comprehending the wave-like characteristics of moving particles. Students will acquire the ability to articulate the movement of particles using wave-packets. Additionally, they will gain an understanding of the principles behind Phase velocity and group velocity.

This lesson provides a concise explanation of the particle-like behavior of waves and the wave-like behavior of particle motion.

UNIT 2: This lesson will educate students on understanding Heisenberg's uncertainty principles, which pertain to the simultaneous measurement of two canonical conjugate pairs of variables, such as location and linear momentum, or energy and time. Studying the Gamma ray microscope and thought experiment will enable students to understand how to assess uncertainty in location and uncertainty in momentum.

By studying two-slit experiments with photons, atoms, and particles, students will get an understanding of the repercussions of the linear Superposition principle of waves. This course will provide students with an understanding of the wave function in quantum physics. They will analyze several characteristics of the wave function. Students will acquire the ability to formulate the Schrodinger equation in one dimension. In addition, they will acquire the skill of normalizing a wave function, as well as calculating the likelihood of position and overall probability. Particle motion current densities.

UNIT 3: Students will learn about the movement of a quantum-mechanical particle that is restricted within a fixed container. They will be capable of determining the eigenvalues of the particle's total energy and the eigenvectors of

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

the particle. Students will have the ability to depict the characteristics of eigenfunctions through the use of appropriate diagrams. Students will acquire knowledge about the concepts of Quantum mechanical scattering and tunneling in one dimension across a step potential barrier. The user intends to construct the one-dimensional Schrödinger equation, solve it, and determine the eigenfunctions. Next, the reflection coefficient, transmission coefficient, and probability of tunneling over the potential barrier will be computed. As an illustration of quantum mechanical tunneling, students will also examine the alpha decay process in radioactivity and be capable of elucidating the alpha decay process through the phenomenon of tunneling.

Students will acquire knowledge about the dimensions, composition, and many characteristics of the nucleus. They will have the capability to compute the density and radius of a nucleus. They will be capable of elucidating the absence of electrons within the nucleus through the use of Heisenberg's uncertainty principle. In addition, they will acquire an understanding of the characteristics of nuclear force and get a comparative understanding of nuclear force in relation to other field forces. Additionally, students will get knowledge of the Liquid drop model and Shell model of the nucleus. The examination of these two nuclear models will assist the learner in developing a comprehensive comprehension of many characteristics of the nucleus. These two nucleus models are highly effective in elucidating the concepts of binding energy and nucleus stability.

UNIT 4: Students will acquire knowledge of the phenomenon of radioactivity and several principles governing radioactive decay. The Half life and Mean life of a radioactive nucleus will be calculated, and these decay laws will be applied by radio carbon dating to determine the age of an ancient wooden sample. Students will also acquire knowledge on the causes of alpha particle, beta particle, and gamma ray emissions, as well as their respective properties in the context of radioactivity. They will have the capability to determine the energy released in alpha decay, beta decay, and gamma ray emission, as well as analyze the characteristics of energy spectra in these three scenarios. The student will attempt to utilize the principles of conservation of energy and angular momentum in the process of beta decay. Through this analysis, they will discover that the apparent violation of these principles in beta decay necessitates the presence of Pauli's neutrino hypothesis in order to explain the continuous beta energy spectrum.

Students will acquire knowledge of nuclear fission and fusion, utilize the energy-mass equivalency formula from relativity, and compute the mass deficit and

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

energy released in these two forms of nuclear reactions. The students will examine the fundamental structure of a nuclear reactor as well as its operational principles. Students will acquire knowledge of fusion, which refers to the thermonuclear reactions that generate star energy. Students will acquire knowledge of the phenomena of spontaneous emission, the development of metastable states, population inversion, optical pumping, stimulated emission, and the relationship between Einstein's A and B coefficients. Then they will be able to comprehend the genesis of LASER. Students will gain knowledge of the operational principles of three-level lasers, four-level lasers, Ruby lasers, and He-Ne lasers, as well as their respective applications.

COURSE: CC9 [ELEMENTS OF MODERN PHYSICS] PRACTICAL (FM 20)

COURSE NAME: Elements of Modern Physics Lab

COURSE OUT COME: Students will learn the Photoelectric effect in details by performing experiments using suitable circuit and they will study the variation of photo current with variation of intensity of incident light and also with the wavelength of light and express these study by drawing suitable graphs. Students will also measure the maximum energy of the photo electrons in terms of stopping potential for different given wavelengths of incident light and then plot the stopping potential versus 1/ wave length graph and will calculate the values of Planck’s constant and photoelectric work function from this graph.

The students will also determine the value of

i) Planck’s constant using blackbody radiation and photo detector.
ii) The value of Planck’s constant by using LEDs of at least four different colours. They will determine the value of,
iii) Thermionic work function of material of filament directly heated vacuum diode.
iv) The wave length of H-alpha emission line of hydrogen atom by using Spectrometer and Hydrogen gas filled discharge tube.
v) Ionization potential of Mercury by using spectrometer and Mercury filled discharge tube.
vi) The wavelength of absorption lines in the rotational spectrum of iodine vapour.
vii) The wave length of laser source by studying the diffraction of the laser through single slit, double slits and plane diffraction grating.

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

viii) The value of the specific charge of electron(i.e. e/m value) by magnetic focusing or using bar magnet and also by performing Millikan oil drop experiment.

ix) Students will also study the tunnelling effect in tunnel diode by drawing I-V characteristics.

COURSE: CC10 [Analog Systems and Applications] (FM 40)

COURSE NAME: Semiconductor diodes, two terminal devices and their applications, bipolar junction transistors, amplifiers

COURSE OUT COME: The students get a comprehensive knowledge of the intricate principles underlying diodes and transistors. Additionally, they will gain an understanding of the design and composition of amplifiers.

COURSE: CC10 [Analog Systems and Applications] PRACTICAL (FM 20)

COURSE NAME: Analog Systems and Applications Lab

COURSE OUT COME: Realization of different properties of diodes, transistors, amplifiers is performed via experimental physical problems.

COURSE: SEC 2A [Basic Instrumentation Skills] (FM 60)

COURSE NAME: Basic of measurement, Electronic voltmeter, Cathode Ray Oscilloscope, Signal Generators and analysis instruments, impedance bridges & Q-meters, digital instruments, digital multimeter

COURSE OUT COME: The students will be instructed on the fundamental construction of voltmeters and ammeters. They will also acquire the skills to utilize them. In addition, they will get knowledge about various errors that can occur during experiments. The fundamentals of CRO, specifically the multimeter, are explained to the pupils.

COURSE: SEC 2B [Renewable Energy and Energy Harvesting] (FM 60)

COURSE NAME: **Unit 1:** Fossil fuels and Alternate Sources of energy, **Unit 2:** Solar Energy, **Unit 3:** Wind Energy Harvesting, **Unit 4:** Ocean Energy Harvesting, **Unit 5:** Geothermal Energy, **Unit 6:** Hydro Energy, **Unit 7:** Piezoelectric Energy Harvesting, **Unit 8:** Electromagnetic Energy Harvesting, **Unit 9:** Demonstration and Experiments

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE OUT COME: **Unit 1:** This course will cover subjects such as fossil fuels and nuclear energy, including their applications and constraints. Subsequently, they will get the capacity to comprehend the pressing requirements of various renewable and non-conventional energy sources. Next, students will be introduced to a comprehensive survey of advancements in various renewable and non-conventional energy sources, such as Solar Energy, Offshore Wind Energy, Tidal Energy, Ocean Thermal Energy, Geothermal Energy, and Hydroelectricity. Students will acquire knowledge on biomass, bio chemical conversion, and biogas generation. Upon completion of this unit, students will possess the ability to advocate for the utilization of renewable and non-conventional energy sources within society, with the aim of fostering sustainable development.

Unit 2: This subject will provide students with a comprehensive understanding of solar energy. Initially, they will acquire knowledge about the significance of solar energy and the process of storing solar energy. Students will be educated on the diverse applications of solar energy, including solar ponds, solar water heaters, solar distillation, solar cookers, solar greenhouses, solar cells, and absorption air conditioning systems. The instruction will cover the operational principles, advantages, and disadvantages of these solar appliances in great depth. Students will be instructed in subjects such as Photovoltaic systems, Photovoltaic models, Equivalent circuits, and Sun tracking systems. By studying the Photovoltaic system and the Sun tracking systems, the students will get knowledge about the engineering of solar systems. This section aims to encourage students to advocate for the adoption of solar energy systems in our everyday lives, highlighting the economic and environmental advantages they offer to our society.

Unit 3: This section will cover the basic principles of wind energy, as well as the benefits and drawbacks associated with its use. Next, they will acquire knowledge regarding the design and operational principles of various components of wind turbine electrical machinery. Upon completion of this course, students will possess the ability to recognize the practical areas where wind energy can be applied in a tropical nation such as India, taking into account the extensive variations in both geographical and atmospheric conditions within our country.

Unit 4: This section of the course will provide students with an understanding of the comparative potential of Ocean Energy in relation to Wind and Solar energy.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

Students will acquire knowledge regarding the properties and statistical aspects of waves. Additionally, they will gain insights into the design and operational concepts of various wave energy devices. Experience the diverse flavors of LaTeX commands for scientific data processing. This will be highly advantageous for them in terms of their future research career in Physics.

Unit 5: In this section the students will get the knowledge of Geothermal Energy Resources and the practical scopes of availability of these resources. They will also learn about the different technologies used for harvesting of geothermal energy.

Unit 6: In this part students will learn about the Hydropower resources and the technologies used for generation of hydroelectric power. Students will also get knowledge about the environmental impacts of infrastructure required for hydroelectric power plant and hence the students will gain awareness about environmental issues.

Unit 7: During the introduction of this unit, students will acquire knowledge about the fundamental principles underlying the piezoelectric effect, the distinct characteristics of this effect, the properties exhibited by various piezoelectric materials, and the mathematical models used to describe piezoelectricity. They will get insight into the modeling of piezoelectric generators by examining various piezoelectric parameters. Ultimately, the students will acquire knowledge regarding the mechanisms of piezoelectric energy harvesting and the diverse applications of piezoelectric effects in various everyday products.

Unit 8: This unit will cover many aspects of Electromagnetic Energy Harvesting. Their research will encompass the physics of linear generators, mathematical models pertaining to linear generators, and many applications of these generators. Students will be educated about carbon capture technology, as well as cells, batteries, and power consumption. Students will get insight into several pressing environmental concerns and the necessity of renewable energy sources for achieving sustainable development. The objective of this lesson is to facilitate the development of eco-consciousness in every student, hence fostering responsible citizenship within our nation.

Unit 9: The aim of this unit is to give some practical exposures to the students on some renewable energy sources. The students will be given demonstrations of training modules on solar energy, wind energy, conversion of vibration into voltage by using piezoelectric materials and conversion of thermal energy into voltage using thermoelectric modules.

COURSE: GE 4A [Electricity and Magnetism] (FM 40)

COURSE NAME: Vector analysis, Electrostatics, Magnetism, Electromagnetic induction, Maxwell's equations and electromagnetic wave propagation.

COURSE OUT COME: Students will learn about the vectors, electrostatics and magnetostatics. They will also learn about the electromagnetic inductions and wave nature of the electromagnetic fields.

COURSE: GE 4A [Electricity and Magnetism] PRACTICAL (FM 20)

COURSE NAME: Electricity and Magnetism lab

COURSE OUT COME: Students will learn about the vectors, electrostatics and magnetostatics. They will also learn about the electromagnetic inductions and wave nature of the electromagnetic fields.

COURSE: GE 4B [Waves and Optics] (FM 40)

COURSE NAME: **Unit 1:** Superposition of two Collinear Harmonic Oscillations, **Unit 2:** Superposition of two Perpendicular Harmonic Oscillations, **Unit 3:** Wave Motion –General, **Unit 4:** Sound, **Unit 5:** Wave Optics, **Unit 6:** Interference of light, **Unit 7:** Michelson's Interferometer, Unit 8: Diffraction of light, **Unit 9:** Polarization of light

COURSE OUT COME: **Unit 1:** Students will be instructed on the concepts of Linearity and Superposition Principle as they apply to two oscillations with identical frequencies. In addition, they will get knowledge regarding the linearity and superposition of two oscillations with distinct frequencies, which consequently leads to the production of beats. Additionally, students will possess the ability to successfully answer both conceptual and numerical issues related to these subjects.

Unit 2: This segment will provide students with an understanding of the graphical and analytical method for superimposing two perpendicular oscillations of the same or different frequency. It will also cover the construction of Lissajous figures. The students will meticulously examine the patterns of Lissajous figures and thereafter render them with precision.

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

Unit 3: Students will get an understanding of the production of transverse waves, travelling waves, and standing waves on a string. The students will acquire knowledge about many characteristics of transverse waves, including travelling waves and standing waves on a string. They will also apply this knowledge to solve numerical problems related to these topics. The students will have the capacity to mathematically represent various forms of waves using appropriate sinusoidal periodic functions. The user will acquire knowledge on the normal modes of vibrations exhibited by a string. They will acquire an understanding of phase velocity and group velocity and will be capable of establishing a mathematical relationship between the two. The pupils will also be instructed on the concepts of Plane waves, Spherical waves, and Wave intensity.

Unit 4: This section of the course will cover topics such as simple harmonic motion, damped vibration, forced vibration, and resonance. Students will acquire the ability to distinguish between Velocity resonance and Amplitude resonance, to graph the resonance curve, and to calculate resonant frequencies, half power frequencies, and bandwidth. They will get understanding of the sharpness of resonance and the quality component of resonance. Students will examine Fourier's theorem and utilize it to analyze Saw-tooth and Square waves. Students will acquire knowledge of units such as decibel and phon, which measure the relative strength and loudness of sound, respectively. Students will gain insight into musical notes and musical scales. In addition, they will receive instruction on the topic of building acoustics. In this context, students will receive instruction on issues such as Reverberation, Reverberation time, and Absorption coefficient. Students will calculate the Sabine's formula. They will possess the capability to compute the reverberation time and comprehend the various acoustic characteristics of halls and auditoriums. This will assist students in the process of designing the inside of a hall and auditorium.

Unit 5: The students in this section will learn about electromagnetic nature of light as a consequence of Maxwell’s equations in Electromagnetism. They will get a very clear idea of wave front and will be able to distinguish between plane wave front, Spherical wave front and Cylindrical wave front. The students will learn the Huygens Principle and will be able to explain the propagation of light wave.

Unit 6: At first the students will learn about the Young’s double slits experiments and the formation of interference fringes. Then they will be able to state the definition of interference. Students will be able to classify the two methods of interference i.e. Division of amplitude and division of wave front. Students will be familiar with the different techniques for production of interference like Fresnel's bi prism method, Lloyd's single mirror method, Newton's rings formation. The students will find the expression of diameter of Newton's rings. By using this expression students will measure the diameter and they will be able to determine the unknown wave length of monochromatic light and the refractive index of liquid. Students will get idea about the fringes of equal inclination and fringes of equal thickness also. Students will also solve a lot of numerical problems.

Unit 7: This section will provide students with an understanding of the many forms or shapes of interference fringes that are created by the Michelson interferometer. Students will acquire knowledge about the construction and operational principles of the Michelson interferometer in a concise manner. Students will be taught the techniques for determining the unknown wavelength of monochromatic light, the difference in wavelengths of a compound light with two wavelengths, and the refractive index of a thin transparent film and its thickness using Michelson's interferometer.

Unit 8: Initially, the students will learn the detailed description of light diffraction and the exact prerequisites that must be met for light diffraction to take place. Students will acquire the ability to distinguish between the two distinct categories of diffraction, namely Fraunhofer diffraction and Fresnel diffraction. The category of Fraunhofer diffraction covers the study of light diffraction through many types of slits, including single, double, and multiple slits, as well as diffraction gratings. Students will learn about the mathematical equations that describe the intensities of the diffraction patterns in each of these cases. Within the realm of Fresnel Diffraction, students will acquire knowledge pertaining to the concepts of half period zones and zone plates. Students can utilize the concept of half period zones to elucidate either the bending, also known as diffraction, of light or the straight-line propagation of light.

Unit 9: In this unit students will learn about the transverse nature of light waves. Then students will understand the mutual orthogonal directions of Electric field, Magnetic field and Propagation of light wave very well. After this the students will learn about the meaning of plane polarized light and methods of production and analysis of this plane polarized light. At last students will get an elementary idea about the circularly polarized light and the elliptically polarized light too.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE: GE 4B [Waves and Optics] PRACTICAL (FM 20)

COURSE NAME: Waves and Optics Lab

COURSE OUT COME: During the practical session,
(i) Students will explore the movement of interconnected oscillators and determine the usual modes of vibrations.
ii) The objective is to determine the frequency of an electrically sustained tuning fork using Melde's experiment and to validate the relationship between wavelength and tension.
iii) The objective is to examine the Lissajous figure using a Cathode Ray Oscilloscope and to graph the waveforms of the individual waves and the combined wave, and then compare them to the theoretical understanding of Lissajous figure generation. iv) Calculate the coefficient of viscosity of water using the capillary flow method, also known as Poiseuille's method.
v) Utilize an optical bench, photo sensor, and laser to quantify the intensities of diffraction patterns produced by a single slit and double slits. Additionally, ascertain the wavelength of the laser.
(vi) Calculate the wavelength of sodium light that is not known by measuring the diameters of Newton's rings using a traveling microscope.
(vii) Use a Fresnel biprism to determine the wavelength of monochromatic light that is currently unknown.
(viii) Ensure correct leveling of the spectrometer. Next, the spectrometer will be adjusted to align the incident rays and emergent rays in parallel using Schuster's focusing approach. Using the spectrometer, students will measure the refracting angle of the prism, determine the refractive indices of the prism's material for different colors of light with specific wavelengths, calculate the values of Cauchy constants, determine the dispersive power of the prism's material, calculate the resolving power of the prism, and find the unknown wavelengths of lights of different colors using a plane diffraction grating and its resolving power.

SEMESTER V

COURSE: CC11 [Quantum Mechanics and Applications] (FM 40)

COURSE NAME: Schrodinger equation, General discussion of bound states in an arbitrary potential, Quantum theory of hydrogen like atoms, atoms in electric & Magnetic fields, atoms in external magnetic fields, many electron atoms.

COURSE OUT COME: The students will be introduced to the fundamental principles of quantum mechanics and its significance. They will explore how quantum mechanics is

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

applied to solve various physical problems, particularly those involving hydrogen-like atoms. The impact of magnetic fields on atoms will also be discussed. Additionally, the students will study many-electron systems.

COURSE: CC11 [Quantum Mechanics and Applications] PRACTICAL (FM 20)

COURSE NAME: Quantum Mechanics and Applications Lab

COURSE OUT COME: Students will learn to use highly sophisticated programming to solve complex quantum mechanical problems.

COURSE: CC12 [Solid State Physics] (FM 40)

COURSE NAME: **Unit 1:** Crystal Structure**, Unit 2:** Elementary Lattice Dynamics, **Unit 3:** Magnetic Properties of Matter, **Unit 4:** Dielectric Properties of materials, **Unit 5:** Ferroelectric Properties of Materials, **Unit 6:** Elementary Band Theory, **Unit 7:** Superconductivity

COURSE OUT COME: **Unit 1:** The first unit will focus on the characteristics and properties of solid materials. They will get knowledge of the geometric arrangement of crystal structures in solid materials. The user will have knowledge of the following concepts: Lattice, Basis, Lattice Translation vectors, Central and Non-central elements, unit cells, Miller indices, Reciprocal lattices, Brillouin zones, and various types of crystal lattices. Subsequently, the pupils will acquire the ability to discern between crystalline and amorphous solid materials. Students will gain knowledge of X-ray diffraction, specifically the process involving crystals and Bragg's rule. This understanding will enable them to determine many characteristics of crystal structure, which are essential for a comprehensive analysis of crystal structure. The students will acquire the ability to compute coordination numbers, packing fractions, volumes of primitive unit cells, atomic factors, and geometrical factors for simple cubic, body-centered cubic, and face-centered cubic crystals.

Unit 2: This part will cover the topics of lattice vibrations and phonons, providing students with a comprehensive understanding of these concepts. The student will investigate the lattice vibrations in linear chains composed of monatomic and diatomic lattices. They can determine the frequencies of these lattice vibrations using lattice parameters, and then distinguish between Acoustical and Optical modes of vibration based on two distinct frequency values. Students will study various theories for determining the specific heat of solids, such as Dulong-Petit's law, Einstein's theory, and Debye's theory, based on lattice vibrations. Studying

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

these theories will enable students to have a comprehensive understanding of the true nature of lattice vibration.

Unit 3: This section of the syllabus covers many magnetic metrics, including the intensity of the magnetic field, magnetic induction field, magnetization vector, magnetic dipole moment, magnetic susceptibility, and magnetic permeability. Subsequently, the pupils will have the capacity to classify all magnetic materials into three distinct categories: Diamagnetic, Paramagnetic, and Ferromagnetic, based on these specific properties. Following this, students will acquire knowledge of the traditional Langevin theories pertaining to diamagnetism and paramagnetism. They will then be capable of deriving the mathematical expression for magnetic susceptibility and establishing a correlation between these expressions and the experimentally determined values of these parameters. Students will also explore the quantum mechanical perspective on paramagnetism and compare the findings with those acquired using the classical approach. Next, the students will explore the principles of ferromagnetic domains, spontaneous magnetization, and Weiss's theory of ferromagnetism. Next, the students will acquire knowledge about the concepts of B-H loop, Magnetic Hysteresis, and Energy loss through discussions. Students will acquire knowledge of the concepts of residual magnetism, magnetic saturation, and coercive force. They will also develop the ability to select the most appropriate magnetic material for a certain purpose based on the desired values of various parameters.

Unit 4: Students will gain the knowledge on dielectric properties of materials in details in this unit. They will learn about electric dipole, electric dipole moment, dielectric polarization , polarization vector, polarizability, electric displacement vector, electric susceptibility, electric permeability and dielectric constant. Students will get the concept of local field and will be able to derive the Clausius Mossotti equation. They will also learn the classical theory of electric polarization and will derive the Langevin- Debye equation involving the polarizability of the dielectric material. Students will also study the phenomena of Normal and Anomalous Dispersion and will derive the Cauchy Sellmeir relations and find the expression of complex dielectric constant of dielectric materials. Students will also learn the Plasma oscillations, Plasma frequency and Plasmons.

Unit 5: In this very important theory part the students will get the knowledge of ferroelectric properties of materials. At first students will learn the structural phase transition of some materials which is the origin of ferroelectricity,

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

piezoelectricity and pyroelectricity in materials. Students will learn about the ferroelectric domains, Curie-Weiss law and Ferroelectric domains. Students will be able to learn the various applications of ferroelectric, piezoelectric and pyroelectric materials

Unit 6: This part focuses on educating students about the characteristics of periodic potential energy and its various manifestations in crystals through the utilization of the Kronig Penny model of periodic potential. Upon acquiring this knowledge, the students will possess the ability to comprehend the process of energy band creation in crystalline solids. Next, the students will acquire the skill of categorizing crystalline solid materials into three overarching classifications: insulators, semiconductors. Next, the students will be introduced to intrinsic and extrinsic semiconductors, the process of doping, and the properties of P-type and N-type semiconductors. They will also learn about the electric mobility of charge carriers in semiconductors and many aspects associated with semiconductors. The students will be instructed on the Hall effect and the procedure for measuring the Hall coefficient using the four probe method.

Unit 7: In the beginning, the students will acquaint themselves with the empirical findings in the realm of superconductivity. Subsequently, the students will acquire comprehension of the principles underlying critical temperature, critical magnetic field, and the Meissner effect, in relation to the empirical findings. Students will have the ability to categorize superconductors into two distinct groups: type I and type II superconductors. To determine the source of the Meissner effect, students will derive the London's equation and subsequently solve it. Subsequently, they will determine the magnetic field's penetration depth into the superconductors. Finally, students will acquire knowledge of the isotope effect and get a basic understanding of the BCS theory of superconductivity.

COURSE: CC12 [Solid State Physics] PRACTICAL (FM 20)

COURSE NAME: Solid State Physics Lab

COURSE OUT COME: The students will be able to use a magnetic flux meter to:

i) Turn on an electromagnet, measure the magnetizing current, and find the magnetic induction field between the two sides of the electromagnet.
ii) Use Quick's method to figure out the magnetic susceptibility of a paramagnetic solution.
iii) Use Guoy's method to figure out the magnetic susceptibility of a solid paramagnetic object.

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

iv) Determine what the piezoelectric crystal's coupling value is.
v) If you know the frequency of a dielectric material, you can find its dielectric constant.
vi) Surface Plasmon Resonance (SPR) can be used to figure out a metal's complicated dielectric constant and plasma frequency.
vii) Surface Plasmon Resonance (SPR) can be used to find the refractive index of a dielectric layer.
viii) Draw the P-E hysteresis loop of a ferroelectric material and look at the different properties that go with it.
ix) Draw the ferromagnetic material's B-H hysteresis loop and look at the different properties that go with it.
x) The four probe method is used to measure how the resistance of a semiconductor, in this case Germanium, changes with temperature. The tests should be done at temperatures ranging from room temperature to 10 degrees Celsius. Also, try to guess the semiconductor's energy band gap.
xi) Do the Hall Effect experiment to find the Hall coefficient and the number distribution of charge carriers.

COURSE: DSE 1A [Advanced Mathematical Physics I] (FM 40)

COURSE NAME: **Unit 1:** Laplace Transform, **Unit 2:** Linear Vector Spaces, **Unit 3:** Cartesian Tensors, **Unit 4:** General Tensors

COURSE OUT COME: **Unit 1:** The students in this subject will be introduced to an additional integral transform, distinct from the Fourier transform. This section on Laplace transform will provide an understanding of the different properties and uses associated with it.

Unit 2: This theory section will introduce students to abstract algebra, covering concepts such as fields, groups, and linear vector spaces. They will acquire knowledge of mappings and matrix representations of linear vector spaces, as well as an understanding of basis, inner product, and orthogonalization. This unit will enable them to conceptualize Quantum Mechanics from a distinct perspective.

Unit 3: This part will talk about algebraic ways to change tensors and how they are used in vector calculus and solid geometry. Students who are doing study in the area of general theory of relativity will benefit a lot from having these skills. They will also be given in-depth descriptions of a number of physical tensors.

Officer-In-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

Unit 4: In this last part of the course the students will get familiar with the tensor algebra in addition to the knowledge about some important tensors like metric tensor, permutation tensor etc.

COURSE: DSE 1A [Advanced Mathematical Physics I] PRACTICAL (FM 20)

COURSE NAME: Advanced Mathematical Physics I Lab

COURSE OUT COME: In the course, students will learn how to use both SCILAB and Python to run models. Through simulations, they will learn how to do things like basic quantum mechanical commutation relations proof, Euclidean geodesic study, solving ground state eigen value problems for simple quantum mechanical systems, Lagrangian formulations for constrained classical systems, and more. There will be a lot more understanding in theoretical and computational physics after taking this course.

COURSE: DSE 1B [Nano-materials and Applications] (FM 40)

COURSE NAME: Nanoscale Systems, Synthesis of Nano structured Materials, Characterization, Optical Properties, Electron Transport and Applications.

COURSE OUT COME: Students will learn about nanostructures in this class. They will learn about 1D, 2D, and 3D nanostructures, such as nanodots, thin films, nanowires, and nanorods. The will be able to make nanomaterials using Top down or Bottom up methods and describe them using XRD, SEM, and TEM methods. We will look into the quantitative study of quasi-particles and excitons along with carrier transport in nanostructures. In different Micro Electromechanical Systems (MEMS) and Nano Electromechanical Systems (NEMS), they will be able to understand how nanomaterial has been used.

COURSE: DSE 1B [Nano-materials and Applications] PRACTICAL (FM 20)

COURSE NAME: Nanomaterials and Applications Lab

COURSE OUT COME: Students in this class will learn how to make metal nanoparticles using chemicals, how to make semiconductor nanoparticles, how to study the XRD pattern of nanomaterials, and how size affects the color of nanomaterials. By spin coating, make a thin film of nanoparticles, Create a thin sheet capacitor and check its capacitance as a function of frequency or temperature. To make a PN diode, spread Al over the surface of N-type Si and look at its V-I profile.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE: DSE 2A [Applied Dynamics] (FM 40)

COURSE NAME: **Unit 1:** Recapitulation of classical mechanics, **Unit 2:** Introduction to Dynamical system, **Unit 3:** Introduction to chaos and fractals, **Unit 4:** Introduction to fluid dynamics

COURSE OUT COME: **Unit 1:** The curriculum for this unit will include Newton's laws of motion, phase portraiture, small amplitude oscillation, equilibrium, and stability, as well as Hamilton's equation of movements.

Unit 2: This theory focuses on teaching students about fundamental concepts in dynamical systems, such as phase space, flows on a one-dimensional line, fixed points, flows on a circle, and discrete dynamical systems.

Unit 3: In this section the students will learn about chaos, different route of chaos, nonlinear time series analysis and chaos characterization. They will also study self similarity and fractal geometry and fractal dimensions etc.

Unit 4: In this last part of the course the students will get familiar with different characteristics of fluid, kinematics of moving fluids, equation of continuity, Bernoulli's theorem, Navier-Stokes' equation.

COURSE: DSE 2A [Applied dynamics] PRACTICAL (FM 20)

COURSE NAME: Applied dynamics Lab

COURSE OUT COME: The students will acquire knowledge in computational and visual representation of various issues in applied dynamics utilizing programming languages such as Python, Scilab, C, Fortran, etc. The study will focus on the dynamics of coupled oscillators, various continuous nonlinear systems, predator-prey dynamics, map dynamics, as well as the visualization of the Sierpinski gasket and fractal fern.

COURSE: DSE 2B [Atmospheric Physics] (FM 40)

COURSE NAME: **Unit 1:** General Features of Earth's atmosphere, **Unit 2:** Atmospheric Dynamics, **Unit 3:** Atmospheric Waves, **Unit 4:** Atmospheric Radar and Lidar, **Unit 5:** Atmospheric Aerosols,

COURSE OUT COME: **Unit 1:** As an introductory component of this course, students will acquire knowledge about the fundamental thermodynamic aspects of Earth's atmosphere, such as clouds, winds, and fogs. They will also gain an understanding of various meteorological phenomena, such as cyclones and thunderstorms, and the architectural methods used to study and classify these aspects.

Unit 2: In this segment students will get handy concepts regarding the basic mechanical laws and equations of motion governing the dynamics of Earth's atmosphere leading to the application especially in different types of circulation.

Unit 3: Students will get an understanding of many types of atmospheric waves, such as Rossby waves, buoyancy waves, and atmospheric gravity waves. Specifically, they will learn about the dispersion, absorption, and movement of these waves.

Unit 4: In this instrumental part of the course the students will acquire the idea to to study different atmospheric phenomena using Radar and Lidar.

Unit 5: The students in this area will receive a comprehensive education on atmospheric aerosols, with a particular focus on the optical phenomena of the atmosphere, specifically pertaining to solar radiation.

COURSE: DSE 2B [Atmospheric Physics] PRACTICAL (FM 20)

COURSE NAME: Atmospheric Physics Lab

COURSE OUT COME: During the practical course, students will engage in simulations with SCILAB. They will acquire the ability to model air waves by analyzing the corresponding dispersion relations. The students will receive instruction on the proper handling of Radar, Lidar, satellite, and Radiosonde data. In addition, they will analyze time series data regarding the temperature profile of a specific area or location. This laboratory course offers promising opportunities for students to enhance their future career prospects, both in terms of employment and research endeavors.

SEMESTER VI

COURSE: CC 13 [Electromagnetic Theory] (FM 40)

COURSE NAME: **Unit 1:** Maxwell Equations, **Unit 2:** EM Wave Propagation in Unbounded Media, **Unit 3:** EM Wave in Bounded Media, **Unit 4:** Polarization of Electromagnetic Waves, **Unit 5:** Wave guides, **Unit 6:** Optical Fibres

COURSE OUT COME: **Unit 1:** In this first section of one of the essential aspects of classical physics, students will acquire a crucial understanding of displacement current and its role in establishing Maxwell's equations. Their investigation will primarily focus on the propagation of electromagnetic waves in a vacuum, based on theoretical principles. In addition, the students acquire a thorough understanding of field potentials, energy density, and the Poynting vector.

Unit 2: In this section the students will get to learn the outcomes propagation of em waves in conductors, dielectrics and plasma leading to know about some very important parameters like skin depth, dielectric constant, plasma frequency etc.

Unit 3: In this section, the students will learn about the reflection and refraction of electromagnetic waves at the boundary between two dielectric materials. They will also get familiar with important laws of electromagnetic theory, such as Fresnel's law and Brewster's law.

Unit 4: In this part the students will learn about the polarization of em waves which includes double refraction, Nicole prism, compensators, wave plates etc. They will also learn the rotator polarization of em waves in deep detail.

Unit 5: The focus of this section will be on instructing the students about planar wave guides and how electromagnetic waves propagate through them. This section aims to provide students with comprehensive knowledge on the transmission of electromagnetic waves in coaxial transmission lines. This knowledge will prove valuable for their future research endeavors as well as their career prospects in job-oriented fields.

Unit 6: In this last part of this course the students will again get a research based knowledge regarding the characterization of optical fibers in a simple but effective way.

COURSE: CC 13 [Electromagnetic Theory] PRACTICAL (FM 20)

COURSE NAME: Electromagnetic Theory Lab

COURSE OUT COME: The students will receive practical training on the subjects discussed in CC 13 (theoretical). They will be taught about theoretical predictions regarding the polarization of electromagnetic waves, as well as how to verify these predictions through experiments. The students will get practical knowledge on polarimeters, compensators, and antennas. This laboratory course will also cover the examination of the reflection, refraction, and radiation properties of electromagnetic waves.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

COURSE: CC 14 [Statistical Mechanics] (FM 40)

COURSE NAME: Classical Statistical Mechanics, Classical Theory of Radiation, Quantum Theory of Radiation, Bose-Einstein Statistics and Fermi-Dirac Statistics.

COURSE OUT COME: It enables students to get fundamental knowledge of Ensemble, partition function, and thermodynamic functions. Students will also acquire knowledge of radiation theory, spanning from classical to quantum physics, including topics such as Wien's Displacement Law. Wien's Distribution Law. The formula for ionization developed by Saha. The Rayleigh-Jeans Law describes the spectral distribution of black body radiation. The principles established by Max Planck on the behavior of energy at the quantum level. Planck's Law describes the radiation emitted by a blackbody. The course also includes the study of two specific types of distribution: the Bose-Einstein distribution law and the Fermi-Dirac distribution law.

COURSE: CC 14 [Statistical Mechanics] PRACTICAL (FM 20)

COURSE NAME: Statistical Mechanics Lab

COURSE OUT COME: The students will receive practical instruction in solving course-related problems using computational methods in the CC 14 theory.

Students will have the ability to use computational methods to analyze the actions of a group of particles confined in a box. These particles follow Newtonian physics and interact with each other through the Lennard-Jones potential. Additionally, students will study concepts such as the partition function, Planck's equation for Black Body radiation, and the specific heat of solids. (a) The Dulong-Petit law, (b) The Einstein distribution function, and (c) The Debye distribution function for high and low temperatures.

COURSE: DSE3A [Nuclear and Particle Physics] (FM 60)

COURSE NAME: **Unit 1:** General properties of Nuclei, **Unit 2:** Nuclear models, **Unit 3:** Radioactive decay, **Unit 4:** Nuclear reactions, **Unit 5:** Interaction of Nuclear radiations with matter, **Unit 6:** Detectors for Nuclear radiations**,** **Unit 7:** Particle Accelerators, **Unit 8:** Particle Physics

COURSE OUT COME: **Unit 1:** The first unit will cover the constituents of the nucleus, their intrinsic properties, and various quantitative data such as mass, radii, charge density, matter density, angular momentum parity, magnetic moment, electric moment, and nuclear excited states. The students will be educated on the concept of

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

binding energy, including the average binding energy and how it changes with the mass number. They will also learn about the key characteristics of the curve that represents the average binding energy vs. mass number.

Unit 2: This part will provide students with an understanding of three nuclear models. Initially, the students will discern the resemblances between a liquid droplet and a nucleus. Next, they will acquire knowledge about the underlying assumptions of these models and deduce the mathematical expression for nuclear binding energy, which encompasses five distinct energy components. They will then compare the resulting binding energy curve derived from this equation with the experimental curves. They will get knowledge about the advantages and disadvantages of the liquid drop model. Next, students will acquire knowledge of the Fermi gas model of the nucleus. Finally, they will thoroughly examine the shell model of the nucleus.

Unit 3: This segment will focus on the fundamental principles of the alpha-decay process. They will get knowledge about the distinct characteristics of the alpha disintegration energy spectrum. Next, the students will acquire knowledge on elucidating the source of alpha decay by an examination of the quantum mechanical phenomenon known as tunneling and Gamow's theory of alpha decay. As a result of Gamow's theory, students will examine the Geiger Nuttall law.
Students will acquire knowledge of the kinematics associated with various forms of beta decay. The researchers will analyze the continuous beta disintegration energy spectrum and attempt to establish a correlation between this spectrum and the principles of energy and angular momentum conservation. It is anticipated that they will discover potential violations of these conservation principles in this context. Pauli's neutrino hypothesis can elucidate the continuous nature of the beta energy spectrum, while also upholding the rules of energy and angular momentum conservation. Students will acquire knowledge about the source of Gamma ray emission, the mechanics of Gamma ray emission, and the source of emission of internal conversion electrons.

Unit 4: This section of the course will cover many categories of nuclear reactions, the conservation rules that govern these reactions, and the kinematics associated with these events. Students will acquire the ability to compute the Q-value, reaction rate, and reaction cross sections, as well as solve associated numerical problems. Students will acquire knowledge of Compound and direct reactions, resonance reactions, as well as Coulomb scattering, commonly known as Rutherford scattering. Understanding Coulomb scattering will provide pupils with knowledge regarding the size of a nucleus.

Unit 5: This section focuses on the study of the interaction between emitted nuclear radiations, such as alpha particles, beta particles, and gamma rays, and matter. The user will acquire knowledge regarding the ionization process of the atoms in the medium as a result of the interaction between the moving alpha particles and the atoms. In addition, they will get knowledge about the phenomenon of energy radiation by electrons, namely beta particles, through the utilization of Cerenkov radiation. Finally, students will acquire knowledge of the interaction between gamma rays and matter. Gamma ray photons can interact with matter through many mechanisms, such as the photoelectric effect, electron-positron pair creation, and Compton scattering. Students will also acquire understanding regarding the Photoelectric effect, Compton scattering, and the pair creation mechanism.

Unit 6: This section of the course will cover the many types of nuclear radiation detectors and their operational principles. Initially, students will be introduced to the construction and operational principles of gas detectors such as the Ionization chamber and Geiger-Muller counter, as well as their respective applications. Next, they will acquire knowledge about the fundamental principle of Scintillation Detectors, as well as the design and operational principle of the Photo Multiplier Tube. Students will acquire information about semiconductor detectors composed of Silicon and Germanium, which are utilized for the detection of charged particles and photons. Finally, the students will also acquire knowledge about the method of neutron detection.

Unit 7: This section of the paper will initially introduce students to the functions of a particle accelerator. Then they will become acquainted with the accelerator facility that is accessible in India. The students will finally acquire knowledge of the construction, operational principles, applications, benefits, and drawbacks of several particle accelerators such as the Van-de Graff generator, Linear accelerator, Cyclotron, and Synchrotrons.

Unit 8: During the final unit of this paper, students will acquire knowledge regarding the fundamental characteristics, classifications, and groupings of elementary particles. Participants will acquire knowledge about various types of interactions and conservation laws, including those related to energy, linear momentum, angular momentum, parity, Baryon number, Lepton number, Isospin, strangeness, and charm. Finally, the students will get knowledge about the Quark model, the color quantum number, and gluons as well.

COURSE: DSE 3B [Advanced Mathematical Physics II] (FM 60)

COURSE NAME: Calculus of Variation, Group Theory, Advanced probability Theory.

COURSE OUT COME: This course will cover the topic of calculus of variations, specifically focusing on Euler-Lagrange's equation, canonical transformation, and Legendre transformation. This course covers the fundamentals of group theory, as well as specific groups with operators. Students will acquire knowledge in binomial and multinomial expansions, as well as probability distributions in advanced probability theory.

COURSE: DSE 4A [Astronomy and Astrophysics] (FM 60)

COURSE NAME: **Unit 1:** Astronomical Scales, **Unit 2:** Astronomical technique, **Unit 3:** Physical principles, **Unit 4:** The sun and the solar family, **Unit 5:** The Milky Way, **Unit 6:** Galaxies**, Unit 7:** Large scale structure and the expanding universe

COURSE OUT COME: **Unit 1:** As part of this course, students will be introduced to astronomical scales and the fundamental principles of positional astronomy, including the Celestial Sphere, Astronomical Coordinate Systems, and Geographical Coordinate Systems.

Fundamental Characteristics of Stars: The topics covered include the determination of distance using the parallax method, the measurement of luminosity through the apparent and absolute magnitude scale, the calculation of distance modulus, the determination of temperature and radius of a star, the classification of stellar spectra, and the use of the Hertzsprung-Russell diagram.

Unit 2: This chapter provides students with concise explanations of fundamental optical topics related to Astronomy, including optical telescopes, telescope mountings, Space telescopes, detectors, and their applications.

Unit 3: Students will get the idea of gravitation in Astrophysics (Virial Theorem, Newton versus Einstein), Systems in Thermodynamic Equilibrium.

Unit 4: This section will cover topics such as the sun, the solar family, the genesis of the Solar system using the nebular model, tidal forces, planetary rings, and extra-solar planets. In addition, they acquire knowledge of stellar spectra and their classification structure, including their temperature dependency, black body approximation, H R diagram, and luminosity classification.

Unit 5: This segment of the course will cover the basic composition and properties of the Milky Way, such as its rotational behavior, as well as the stars and stellar clusters included inside it. In addition, they will analyze the characteristics pertaining to the galactic nucleus.

Unit 6: This unit will cover the study of galaxy morphology, including Hubble's classification of galaxies, such as elliptical, spiral, and lenticular galaxies. Additionally, it will explore the Milky Way galaxy, the presence of gas and dust within it, and the concept of spiral arms.

Unit 7: Cosmic Distance Ladder, Hubble's Law (Distance- Velocity Relation), Clusters of Galaxies (Virial theorem and dark matter).

COURSE: DSE 4B [Classical Dynamics] (FM 60)

COURSE NAME: **Unit 1:** Classical Mechanics of Point Particles, **Unit 2:** Small Amplitude Oscillations, **Unit 3:** Special Theory of Relativity, **Unit 4:** Fluid Dynamics

COURSE OUT COME: **Unit 1:** This section will focus on the examination of Newtonian mechanics and its application to the movement of a charged particle in external electric and magnetic fields. In addition, they will explore the concepts of generalized coordinates and velocities, as well as review the principles of Lagrangian and Hamiltonian mechanics. The discussion will also cover the characteristics of the simple harmonic oscillator, central force field, effective potential, and the Laplace-Runge-Lenz vector.

Unit 2: This section covers the study of the consequences of potential energy minima and stable equilibrium points, the expansion of potential energy around minimum, minor oscillations with low amplitude around the minimum, and the typical modes of oscillations.

Unit 3: This section will cover the study of the special theory of relativity, which includes the postulates of the theory, Lorentz transformations, Minkowski space, space-time diagrams, time dilation, length contraction, the twin paradox, four-velocity and acceleration, the Doppler effect from a four-vector perspective, conservation of four-momentum, and relativistic kinematics.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong

Unit 4: This section of the course will cover topics such as fluid density and pressure, the properties of fluid elements including velocity, the continuity equation and mass conservation, Poiseuille's equation for fluid flow, the Navier-Stokes equation, a qualitative description of turbulence, and the Reynolds number.

Officer-in-Charge
Government General Degree College
at Pedong

Head
Department of Physics
Government General Degree College
at Pedong