DEPARTMENT OF PHYSICS

GOVERNMENT OF MANIPUR , KAKCHING KHUNOU COLLEGE, KAKCHING KHUNOU

PROGRAM SPECIFIC OUTCOME:

Student graduating with the B. Sc Physics degree should be able to

- **Acquire**

❖ A fundamental/systematic and coherent understanding of the academic field of basic Physics in areas like Mechanics, Electricity and Magnetism, Waves and Optics, Thermal and Statistical Physics, Quantum Mechanics, Mathematical Physics and their applications to other core subjects in Physics;

❖ A wide ranging and comprehensive experience in physics laboratory methods in experiments related to mechanics, optics, thermal physics, electricity, magnetism,digital electronics, solid state physics and modern physics. Students should acquire the ability for systematic observations,use of scientific research instruments, analysis of observational data, making suitable error estimates and scientific report writing

❖ Procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Physics, including professionals engaged in research and development, teaching and government/public service;

❖ Knowledge and skills in areas related to their specialization area corresponding to elective subjects within the disciplinary/subject area of Physics and current and emerging developments in the field of Physics.

❖ Demonstrate the ability to use skills in Physics and its related areas of technology for formulating and tackling Physics-related problems and identifying and applying appropriate physical principles and methodologies to solve a wide range of problems associated with Physics.

❖ Recognize the importance of mathematical modelling, simulation and computational methods, and the role of approximation and mathematical approaches to describing the physical world and beyond.

❖ Plan and execute Physics-related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report

accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Physics.

NEW SYLLEBUS NEP 2022

SEMESTER I

CORE-I :PHY 501C (MATHEMATICAL PHYSICS-I)

COURSE OUTCOME:

After learning this course, students will be be able to

- ✧ Draw and interpret graphs of various functions.
- ✧ Solve first and second order differential equations and apply these to physics problems. Understand the concept of gradient of scalar field and divergence and curl of vector fields.
- ✧ Perform line, surface and volume integration and apply Green's, Stokes' and Gauss's
- ✧ Apply curvilinear coordinates to problems with spherical and cylindrical symmetries. distribution functions.
- ✧ In the laboratory course, the students will be able to design, code and test simple programs in C++ in the process of solving various problems.

CORE- II: PHY 502C (MECHANICS)

COURSE OUTCOME:

After learning this course, students will be able to

- ✧ Understand laws of motion and their application to various dynamical situations.
- ✧ Learn the concept of inertial reference frames and Galilean transformations. Also, the

concept of conservation of energy, momentum, angular momentum and apply them to basic problems.

- ✧ Understand translational and rotational dynamics of a system of particles.
- ✧ Apply Kepler' s laws to describe the motion of planets and satellite in circular orbit.
- ✧ Understand concept of Geosynchronous orbits.
- ✧ Explain the phenomenon of simple harmonic motion.
- ✧ Understand special theory of relativity - special relativistic effects and their effects on the mass and energy of a moving object.
- ✧ In the laboratory course, the student shall perform experiments related to mechanics: compound pendulum, rotational dynamics (Flywheel), elastic properties (Young Modulus and Modulus of Rigidity), fluid dynamics, estimation of random errors in the observations etc.

SKILL ENHANCEMENT COURCE(SEC): PHY 501S (ELECTRICAL CIRCUITS & NETWORK SKILLS

- ✧ Demonstrate good comprehension of basic principles of electricity including ideas about voltage, current and resistance.
- ✧ Develop the capacity to analyze and evaluate schematics of power efficient electrical circuits while demonstrating insight into tracking of interconnections within elements while identifying current flow and voltage drop.
- ✧ Gain knowledge about generators, transformers and electric motors. The knowledge would include interfacing aspects and consumer defined control of speed and power.
- ✧ Acquire capacity to work theoretically and practically with solid-state devices. Delve into practical aspects related to electrical wiring like various types of conductors and cables, wiring-Star and delta connections, voltage drop and losses.
- ✧ Measure current, voltage, power in DC and AC circuits, acquire proficiency in fabrication of regulated power supply.
- ✧ Develop capacity to identify and suggest types and sizes of solid and stranded cables, conduit lengths, cable trays, splices, crimps, terminal blocks and solder

SEMESTER-II

CORE-III: PHY 503C (ELECTRICITY & MAGNETISM)

COURSE OUTCOME:

At the end of this course the student will be able to

- ✧ Demonstrate the application of Coulomb's law for the electric field, and also apply it to systems of point charges as well as line, surface, and volume distributions of charges.
- ✧ Demonstrate an understanding of the relation between electric field and potential, exploit the potential to solve a variety of problems, and relate it to the potential energy of a charge distribution.
- ✧ Apply Gauss's law of electrostatics to solve a variety of problems.
- ✧ Calculate the magnetic forces that act on moving charges and the magnetic fields due to currents (Biot- Savart and Ampere laws)
- ✧ Understand the concepts of induction and self-induction, to solve problems using Faraday's
- ✧ Understand the basics of electrical circuits and analyze circuits using Network Theorems.
- ✧ In the laboratory course the student will get an opportunity to verify network theorems and study different circuits such as RC circuit, LCR circuit. Also, different methods to measure low and high resistance, capacitance, self-inductance, mutual inductance, strength of a magnetic field and its variation in space will be learn.

CORE-IV; PHY 504C (WAVES AND OPTICS)

On successfully completing the requirements of this course, the students will have the skill and knowledge to:

- ✧ Understand Simple harmonic oscillation and superposition principle.

- ✧ Understand different types of waves and their velocities: Plane, Spherical, Transverse, Longitudinal.
- ✧ Understand Concept of normal modes in transverse and longitudinal waves: their frequencies and configurations.
- ✧ Understand Interference as superposition of waves from coherent sources derived from same parent source.
- ✧ Demonstrate basic concepts of Diffraction: Superposition of wavelets diffracted from aperture, understand Fraunhoffer and Fresnel Diffraction.
- ✧ In the laboratory course, student will gain hands-on experience of using various optical instruments and making finer measurements of wavelength of light using Newton Rings The motion of coupled oscillators, study of Lissajous figures and behaviour of transverse, longitudinal waves can be learnt in this laboratory course.

SKILL ENHANCEMENT COURSE (SEC)-II: PHY 503S (RENEWABLE ENERGY & ENERGY HARVESTING)

COUSE OUTCOME:

At the end of this course, students will be able to achieve the following learning outcomes:

- ✧ Knowledge of various sources of energy for harvesting
- ✧ Understand the need of energy conversion and the various methods of energy Storage.
- ✧ A good understanding of various renewable energy systems, and its components.
- ✧ Knowledge about renewable energy technologies, different storage technologies, distribution grid, smart grid including sensors, regulation and their control.
- ✧ Design the model for sending the wind energy or solar energy plant.
- ✧ The students will gain hand on experience of:

  (i) different kinds of alternative energy sources,

  (ii) conversion of vibration into voltage using piezoelectric materials,

  (iii) conversion of thermal energy into voltage using thermometric module

SEMESTER-III

CORE-V: PHY 605C (MATHEMATICAL PHYSICS)

COURSE OUTCOME:

On successfully completing this course, the students will be able to

- ✧ Represent a periodic function by a sum of harmonics using Fourier series and their applications in physical problems such as vibrating strings etc.
- ✧ Obtain power series solution of differential equation of second order with variable coefficient using Frobenius method.
- ✧ Understand properties and applications of special functions like Legendre polynomials, Bessel functions and their differential equations and apply these to various physical problems such as in quantum mechanic.
- ✧ Learn about gamma and beta functions and their applications.
- ✧ Solve linear partial differential equations of second order with separation of variable method.
- ✧ In the laboratory course, the students will learn the basics of the Scilab software/Python interpreter and apply appropriate numerical method to solve selected physics problems both using user defined and inbuilt functions from Scilab/Python. They will also learn34 to generate and plot Legendre polynomials and Bessel functions and verify their recurrence relation.

CORE-VI: PHY 606C (THERMAL PHYSICS)

COURSE OUTCOME:

At the end of the course, students will be able to:

- ✧ Comprehend the basic concepts of thermodynamics, the first and the second law of thermodynamics.

- ✧ Understand the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations.
- ✧ Know about reversible and Irreversible processes.38

  Learn about Maxwell's relations and use them for solving many problems inThermodynamics

✧ Understand the concept and behavior of ideal and real gases.

- ✧ Learn the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equitation of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion.
- ✧ In the laboratory course, the students are expected to do some basic experiments in conductivity of good and bad conductor, temperature coefficient of resistance, variation of thermo-emf of a thermocouple with temperature difference at its two junctions and calibration of a thermocouple.

CORE- VII: PHY 607C (DIGITAL SYSTEMS AND APPLICATIONS)

COURSE OUTCOME:

- ✧ This course lays the foundation for understanding the digital logic circuits and their use in combi-national and sequential logic circuit design. It also imparts information about the basic architecture, memory and input/output organization in a microprocessor system. The students also learn the working of CRO.
- ✧ Course learning begins with the basic understanding of active and passive components. It then builds the concept of Integrated Chips (IC): its classification and uses.
- ✧ Differentiating the Analog and Digital circuits, the concepts of number systems like Binary,BCD, Octal and hexadecimal are developed to elaborate and focus on the digital systems.
- ✧ Sequential Circuits: Basic memory elements Flips-Flops, shift registers and 4-bits counters leading to the concept of RAM, ROM and memory organization.
- ✧ Timer circuits using IC 555 providing clock pulses to sequential circuits and develop multivibrators.

- ✧ Introduces to basic architecture of processing in an Intel 8085 microprocessor and to Assembly Language.

- ✧ Also impart understanding of working of CRO and its usage in measurements of voltage, current, frequency and phase measurement.
  In the laboratory students will learn to construct both combi national and sequential circuits by employing NAND as building blocks and demonstrate Adders, Subtractors, Shift Registers, and multi-vibrators using 555 ICs. They are also expected to use μP 8085 to demonstrate the same simple programme using assembly language and execute the programme using a μP kit.

SEMESTER IV

CORE VIII: PHY 608C (MATHEMATICAL PHYSICS-III)

COURSE OUTCOME:

After completing this course, student will be able to

- ✧ Determine continuity, differentiability and analyticity of a complex function, find the derivative of a function and understand the properties of elementary complex functions.
- ✧ Work with multi-valued functions (logarithmic, complex power, inverse trigonometric function) and determine branches of these functions

- ✧ Evaluate a contour integral using parametrization, fundamental theorem of calculus and Cauchy'sintegralformula.

- ✧ Find the Taylor series of a function and determine its radius of convergence.

- ✧ Determine the Laurent series expansion of a function in different regions, find the residues and use the residue theory to evaluate a contour integral and real integral.

- ✧ Understand the properties of Fourier and Laplace transforms and use these to solve boundary value problems.

  ✧ In the laboratory course, the students will learn the basics of the Scilab software/Python interpreter and apply appropriate numerical method to solve selected physics problems both using user defined and inbuilt functions from Scilab/Python.

CORE-IX: PHY 609 (ELEMENTS OF MODERN PHYSICS)

After getting exposure to this course, the following topics would be learnt:

- ✧ Main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics.

- Formulation of Schrodinger equation and the idea of probability interpretation associated with wave-functions.
- The spontaneous and stimulated emission of radiation, optical pumping and population inversion. Three level and four level lasers. Ruby laser and He-Ne laser in details. Basic lasing
- The properties of nuclei like density, size, binding energy, nuclear forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
- Decay rates and lifetime of radioactive decays like alpha, beta, gamma decay. Neutrino, its properties and its role in theory of beta decay.
- Fission and fusion: Nuclear processes to produce nuclear energy in nuclear reactor and stellar energy in stars.
- In the laboratory course, the students will get opportunity to measure Planck's constant, verify photoelectric effect, determine e/m of electron, Ionization potential of atoms, study emission and absorption line spectra. They will also find wavelength of Laser sources by single and Double slit experiment, wavelength and angular spread of He-Ne Laser using plane diffraction grating.

CORE-X: PHY 610 (ANALOG SYSTEM AND APPLICATIONS)
COURSE OUTCOME:

At the end of this course, the following concepts will be learnt

- Characteristics and working of pn junction.
- Two terminal devices: Rectifier diodes, Zener diode, photodiode etc.
- NPN and PNP transistors: Characteristics of different configurations, biasing, stabilization and their applications.
- CE and two stage RC coupled transistor amplifier using h-parameter model of the Designing of different types of oscillators and their stabilities.
- Ideal and practical op-amps: Characteristics and applications.
- In the laboratory course, the students will be able to study characteristics of various diodes and BJT. They will be able to design amplifiers, oscillators and DACs. Also different applications using Op-Amp will be designed.

SEMESTER- V

CORE -XI: PHY 711C (QUANTUM MECHANICS & APPLICATIONS)
CORSE OUTCOME:
The Students will be able to learn the following from this course:

- Methods to solve time-dependent and time-independent Schrodinger equation.

- Quantum mechanics of simple harmonic oscillator.
- Non-relativistic hydrogen atom: spectrum and eigenfunctions.
- Angular momentum: Orbital angular momentum and spin angular momentum.
- Bosons and fermions - symmetric and anti-symmetric wave functions.
- Application to atomic systems
- In the laboratory course, with the exposure in computational programming in the computer lab, the student will be in a position to solve Schrodinger equation for ground state energy and wave functions of various simple quantum mechanical one-dimensional and three-dimensional potentials

CORE-XII: PHY 712 (SOLID STATE PHYSICS)
COURSE OUTCOME:

On successful completion of the module students should be able to

- Elucidate the concept of lattice, crystals and symmetry operations.
- Understand the elementary lattice dynamics and its influence on the properties of materials.
- Describe the main features of the physics of electrons in solids: origin of energy bands, and their influence electronic behavior.
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- Explain the origin of dia-, para-, and ferromagnetic properties of solids.
- Explain the origin of the dielectric properties exhibited by solids and the concept of polarizability.
- Understand the basics of phase transitions and the preliminary concept and experiments related to superconductivity in solid.
- In the laboratory students will carry out experiments based on the theory that they have learned to measure the magnetic susceptibility, dielectric constant, trace hysteresis loop. They will also employ to four probe methods to measure electrical conductivity and the hall set up to determine the hall coefficient of a semiconductor.