M.Sc (Physics) Programme (CBCSS-PG-2020)

Course Outcome

1. PHY1C01: CLASSICAL MECHANICS

C.O.1: Explain the fundamental concepts in Lagrangian and Hamiltonian formulation in mechanics.

C.O.2: Apply the concepts of Lagrangian, Hamiltonian, Action, Poisson brackets, canonical tranformations and their subsequent development to Heisenberg's matrix mechanics and Schrodinger's wave mechanics, to carry out numerical problems.

C.O.3: Develop the analytical and mathematical skills for describing the dynamics of rigid bodies. It could be applied to practical situations. This can be applied spectroscopic analysis of samples.

C.O.4: Explain the theory of small oscillations. Small oscillations are part and parcel of all bound physical systems.

C.O..5: Elucidate the concepts in nonlinear dynamics and chaos. These techniques can be directly applied in nonlinear physics and also to verify various experimental results

2. PHY1C02: MATHEMATICAL PHYSICS – I

C.O.1: Describe coordinate systems appropriate for different physical problems. Applies it to solve Laplace's equation in different coordinate systems

C.O.2: Perform transformation operations and get the corresponding transformation matrices. Learns procedures for matrix diagonalisation.

C.O.3 : Distinguish the class of objects called tensors, their classifications and use. Understand differential equations of special nature and the ways to solve them.

C.O.4: Identify differential equations of special nature and the ways to solve them.

C.O.5: Illustrate special functions as solutions to problems in atomic, molecular, nuclear, and solid state physics etc. and will put them in use.

C.O.6: Distinguish Fourier series and integral transforms of different types and their properties. This will enable him/her to analyse or solve different mathematical problems in physical sciences.

3. PHY1C03: ELECTRODYNAMICS AND PLASMA PHYSICS

C.O.1: Explain the significance of displacement current and Maxwell's equations and general electromagnetic wave equations, their solutions in terms of potentials and fields. Another basic concept of physics called gauge transformation will be

understood. Multipole expansion of the potentials, fields and multipole moments of different orders will be learned..

C.O.2: Describe the propagation of electromagnetic waves through free space and the consequences of reflection from different types of boundaries. These have important consequences in wave propagation.

C.O.3: Discusses propagation of electromagnetic waves through confined media like wave guides and cavity resonators.

C.O.4: Enables to appreciate the magnificent results of the blending of relativity and electrodynamics and motivates to take up a course on quantum field theory, the study of fields, interactions and symmetries.

C.O.5: Understand the criteria for a medium to be called plasma and the various properties of it.

4. **PHY1C04: ELECTRONICS**

C.O.1:Analyse characteristics of JFET and MOSFET and their specific applications.

C.O.2: Distinguish the basic characteristics of light emitting and light sensing devices and illustrate the basic concepts behind integrating electronic and photonic devices suitably for microwave communication.

C.O.3: Classify characteristics of op-amps and their implementation in various elementary level applications.

C.O.4: Identify the basics of logic gates, flip flops and registers and the designing of counters, satisfying specific conditions. Understands RAM and D/A converter and basic features of specific microprocessors.

5. **PHY2C05: QUANTUM MECHANICS-I**

C.O.1: Appreciate the importance and implication of vector spaces. Will be able to use Dirac ket and bra notations. Use operators and will be able to solve eigen value problems. Understand generalized uncertainty principle in quantum mechanics and the need for quantum mechanical formalism and its basic principles.

C.O.2: Explain time evolution of quantum mechanical systems and learn different time evolution approaches -Schrodinger picture and Heisenberg picture. Apply different approaches in quantum dynamics to various fundamental problems.

C.O.3: Develop a better understanding of the mathematical foundations of spin and angular momentum. Make use of spherical harmonics to compute Clebsch - Gordon coefficients.

C.O.4: Apply Schrodinger's equation to central potentials problems, to solve various quantum mechanical problems.

C.O.5: Understand invariance principles based on symmetry of the system and establish the associated conservation laws. These quantum mechanical concepts will be applied to analyse the ground state of Helium atom. Here it will be understood that all symmetry elements possess the mathematical property of groups.

6. **PHY2C06: MATHEMATICAL PHYSICS-II**

C.O.1: In general, physical phenomena are expressed in equations involving complex quantities. Some times we get complex solutions to equations. Solving such problems requires special procedures. On completing this module he/she will be gain the skill for solving and interpreting such problems.

C.O.2: Acquire a preliminary training in group theory. All symmetry elements possess the mathematical property of groups. Concepts of group theory will help to solve problems in quantum mechanics. It is quantum mechanics that gives more stress on symmetry than classical mechanics.

C.O.3: Apply the techniques of calculus of variation to diverse problems in physics.

C.O.4: Apply the Greens function technique to solve problems showing causality relationships.

7. **PHY2C07: STATISTICAL MECHANICS**

C.O.1: Understand macroscopic and the microscopic states, thermodynamic potentials, basic concepts of entropy, Liouville's theorem and its consequences. Also the students will have an understanding of the connection between statistics and thermodynamics.

C.O.2: Have a detailed understanding different canonical ensembles.

C.O.3: Develop an understanding of the statistical behavior of Bose-Einstein and Fermi-Dirac systems.

8. **PHY2C08: COMPUTATIONAL PHYSICS**

C.O.1: Write computer programs using core python

C.O.2: Use advanced mathematical modules like Numpy and Pylab in python program for solving mathematical and physical problems and also to present the result visually using graphs and charts.

C.O.3: Solve numerically mathematical problems like interpolation, curve fitting, integration etc. and to write python programs for these.

C.O.4: Solve numerically mathematical problems like differential equations, Fourier transforms etc. and also to write python program for these.

C.O.5: Analyse by simulating simple physical problems in physics like one-dimensional and two-dimensional motion, harmonic oscillator, radio active disintegration,

chaos, solution of Schrodinger equation etc., using python programs by applying the knowledge acquired for the course.

9. **PHY3C09: QUANTUM MECHANICS –II**

C.O.1: Understand time independent perturbation theory and to apply it to harmonic and anharmonic oscillators, and learn the fine structure and hyperfine splitting of Hydrogen atom in the presence of external magnetic and electric fields.

C.O.2: Apply methods like Ritz variational technique and WKB approximation to quantum mechanical systems.

C.O.3: Interpret time dependent perturbation theory and apply it to describe radiative transitions in atoms. Understand Fermi's Golden rule and learn Born approximation.

C.O.4: Explain the theory of scattering and apply the method of partial waves to scattering by central potential and square well potential.

C.O.5: Identify the principles of relativistic quantum mechanics and apply to Dirac particles, Klein-Gordon equation. Also understand the concept of spinors and the non-relativistic limit and Hole theory.

10. **PHY3C10: NUCLEAR AND PARTICLE PHYSICS**

C.O.1: Interpret the properties of nucleus, binding energy, angular momentum, two nucleon scattering, spin dependence, tensor force, partial wave concept and the theory of deuteron structure.

C.O.2: Elucidate the theory of various types of nuclear decay, selection rules oftransition, concept of parity and multipole moments.

C.O.3: Compare various nuclear models and nuclear processes like fission and fusion. Will be able to apply it to various nuclear systems in the chart of nuclides.

C.O.4: Demonstrate the working of one or two nuclear radiation detectors of different types and the signal processing and analysing units.

C.O.5: Compare basic interactions and classify the elementary particles. Interactions are linked with the concept of symmetry and conservation laws. Understand Sakata model, Gellmann- Okubo mass formula, Quark mode and their significance.

11. **PHY3C11: SOLID STATE PHYSICS**

C.O.1: Analyse the structure of materials based on X-ray diffraction and interpret it on the basis of the theory understood.

C.O.2: Distinguish different excitations in crystals. Properties of quasiparticles could be explained. Arrive at proper explanation of for specific heat.

C.O.3: Explain free electron model and interpret the properties of metals. Gain a deeper understanding of the energy bands based on the properties of carriers.

C.O.4: Interpret properly the thermal, electrical and magnetic properties of materials. Will enable the student to understand the current research going on in the related areas.

C.O.5: Illustrate using phase diagrams, phase transitions in materials leading to superconductivity and different types of superconductors.

12. **PHY3E07: INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY**

C.O.1: Comprehend the basic principles of nanoscience and nanotechnology

C.O.2: Have an idea of the structure of nanoparticles

C.O.3: Explore the size dependence of various properties

C.O.4: Evaluate different quantum systems in zero, one, two and three dimension at the nanoscale

C.O.5: Predict the quantum effect on the properties of nanomaterials

13. **PHY4C12: ATOMIC AND MOLECULAR SPECTROSCOPY**

C.O.1: Understand the behavior of atoms and molecules and their interactions with electromagnetic waves.

C.O.2: Apply the behaviour of nonrigid rotor and understand the microwave spectroscopy

C.O.3: Distinguish between Raman and IR spectroscopy and elucidate on the features of Raman spectrum.

C.O.4: Explain electronic spectroscopy and applications

C.O.5: Identify the structure of the sample from spin resonance and Mossbauer spectra

14. **PHY4E16: SYNTHESIS, CHARACTERIZATION TECHNIQUES AND APPLICATIONS OF NANOMATERIALS**

CO1. Identify the different physical and chemical methods of synthesis of nanomaterials

CO2. Understand the working principles of optical property and compositional and morphological analysis related instrumentation techniques

CO3. Learn the fundamentals of electrical and magnetic property related instrumentation techniques

CO4. Recognize different application of nanomaterials in physics, chemistry and medicinal areas

CO5. Have a basic idea of nanomachines and nanodevices

15. **PHY4E24: BIOPHYSICS**

C.O.1: Appreciate the physical mechanism of plant and animal tissues

C.O.2: Identify and understand the foundations of Biophotonics and Biosensing

C.O.3: Understand basic principles, mechanisms of action and applications of biosensors in different scenarios

C.O.4: Analyse biomaterials and composites through theory and experiments

C.O.5: Understand the applications of biomaterials in Medicine and dentistry