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

Programme specific outcomes:
On successful completion of the M.Sc Physics programme, students will
P.O.1 aquire a comprehensive knowledge in physics.
P.O.2 will develop a broad understanding of the physical principles of the universe.
P.O.3 acquire laboratory skills to design advanced experiments and high precision measurements.
P.O.4 be proficient in computing and interfacing techniques.

P.O.5 be empowered for critical thinking and innovation in dealing with scientific problems and experiments.
P.O.6 develop advanced laboratory techniques and instrumentation skills for a career in research.
P.O.7 develop independent research skills through projects.
P.O.8 be provided with opportunities to further their knowledge in frontier areas through elective courses.
P.O.9 be empowered for planning career in physical sciences and also in taking up jobs in other fields in the contemporary society.
P.O.10 be able to communicate effectively and participate actively in team work.

Course Outcomes

PHY1C01: CLASSICAL MECHANICS (4C, 72 hrs)

CO1	Explain the fundamental concepts in Lagrangian and Hamiltonian formulation in mechanics.
CO2	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.
CO3	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.
CO4	Explain the theory of small oscillations. Small oscillations are part and parcel of all bound physical systems.
CO5	Elucidate the concepts in nonlinear dynamics and chaos. These techniques can be directly applied in nonlinear physics and also to verify various experimental results.

PHY1C02: MATHEMATICAL PHYSICS – I (4C, 72 hrs)

CO1	Describe coordinate systems appropriate for different physical problems. Applies it to solve Laplace's equation in different coordinate systems.
CO2	Perform transformation operations and get the corresponding transformation matrices. Learns procedures for matrix diagonalisation.
CO3	Distinguish the class of objects called tensors, their classifications and use. Understand differential equations of special nature and the ways to solve them.
CO4	identify differential equations of special nature and the ways to solve them.
CO5	Illustrate special functions as solutions to problems in atomic, molecular nuclear, and solid state physics etc. and will put them in use.
CO6	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.

PHY1C03: ELECTRODYNAMICS AND PLASMA PHYSICS (4C, 72 hrs)

CO1	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.
CO2	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.
CO3	Discusses propagation of electromagnetic waves through confined media like wave guides and cavity resonators.
CO4	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.
CO5	Understand the criteria for a medium to be called plasma and the various properties of it.

PHY1C04: ELECTRONICS (4C, 72 hrs)

CO1	Analyze characteristics of JFET and MOSFET and their specific applications.
CO2	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.
CO3	Classify characteristics of op-amps and their implementation in various elementary level applications.
CO4	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.

PHY2C05: QUANTUM MECHANICS-I (4C, 72 hrs)

CO1	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.
CO2	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.
CO3	Develop a better understanding of the mathematical foundations of spin and angular momentum. Make use of spherical harmonics to compute Clebsch - Gordon coefficients.
CO4	Apply Schrodinger's equation to central potentials problems, to solve various quantum mechanical problems.
CO5	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.

PHY2C06: MATHEMATICAL PHYSICS-II (4C, 72 hrs)

CO1	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.
CO2	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.
CO3	Apply the techniques of calculus of variation to diverse problems in physics.
CO4	Apply the Greens function technique to solve problems showing causality relationships.

PHY2C07: STATISTICAL MECHANICS (4C, 72 hrs)

CO1	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.
CO2	Have a detailed understanding different canonical ensembles.
CO3	Develop an understanding of the statistical behavior of Bose-Einstein and Fermi-Dirac systems.

PHY2C08: COMPUTATIONAL PHYSICS (4C, 72 hrs)

CO1	Write computer programs using core python
CO2	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.
CO3	Solve numerically mathematical problems like interpolation, curve fitting, integration etc. and to write python programs for these.
CO4	Solve numerically mathematical problems like differential equations, Fourier transforms etc. and also to write python program for these.
CO5	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.

PHY3C09: QUANTUM MECHANICS –II (4C, 72 hrs)

CO1	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.
CO2	Apply methods like Ritz variational technique and WKB approximation to quantum mechanical systems.
CO3	Interpret time dependent perturbation theory and apply it to describe radiative transitions in atoms. Understand Fermi's Golden rule and learn Born approximation.
CO4	Explain the theory of scattering and apply the method of partial waves to scattering by central potential and square well potential.
CO5	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.

PHY3C10: NUCLEAR AND PARTICLE PHYSICS (4C, 72 hrs)

CO1	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.
CO2	Elucidate the theory of various types of nuclear decay, selection rules of transition, concept of parity and multipole moments.
CO3	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.
CO4	Demonstrate the working of one or two nuclear radiation detectors of different types and the signal processing and analysing units.
CO5	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.

PHY3C11: SOLID STATE PHYSICS (4C, 72 hrs)

CO1	Analyse the structure of materials based on X-ray diffraction and interpret it on the basis of the theory understood.
CO2	Distinguish different excitations in crystals. Properties of quasi particles could be explained. Arrive at proper explanation of for specific heat.
CO3	Explain free electron model and interpret the properties of metals. Gain a deeper understanding of the energy bands based on the properties of carriers.
CO4	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.
CO5	Illustrate using phase diagrams, phase transitions in materials leading to superconductivity and different types of superconductors.

ELECTIVES

PHY3E03: RADIATION PHYSICS (4C, 72 hrs)

CO1	Verify through experiments that radiations are primarily divided into ionising and nonionising. Also understand different sources under each category. Production methods of each will also be identified.
CO2	Analyse the interaction mechanism of each category, giving emphasize to scattering and absorption.
CO3	Exposure leads to beneficial or harmful effects. Understands details of both.
CO4	Analyse both stochastic and deterministic effects depending upon radiation dose received.
CO5	Implement proper shielding in laboratory where sources are stored and in transportation.
CO6	After M.Sc. Physics, if PG Diploma courses of BARC or other recognised

	institutions are carried out, there are plenty of opportunities for radiation physicists in an outside the country.

PHY4C12: ATOMIC AND MOLECULAR SPECTROSCOPY (4C, 72 hrs)

CO1	Understand the behavior of atoms and molecules and their interactions with electromagnetic waves.
CO2	Apply the behaviour of nonrigid rotor and understand the microwave Spectroscopy
CO3	Distinguish between Raman and IR spectroscopy and elucidate on the features of Raman spectrum.
CO4	Explain electronic spectroscopy and applications
CO5	Identify the structure of the sample from spin resonance and Mossbauer spectra

PHY4E14: LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS (4C, 72 hrs)

CO1	Understand the basic laser theory and the important laser systems.
CO2	Analyse the fundamentals of non linear optics and its applications.
CO3	Identify the applications of lasers in various disciplines.
CO4	Learn the importance of materials in nanoscale region and the quantum effect of nanomaterials.
CO5	Identify applications of lasers in various disciplines.
CO6	Understand the basics of Optical Fibers and its applications.

PHY4E23: MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS (4C, 72 hrs)

CO1	to be equipped with essential knowledge on design and programming of simple microprocessor based systems.
CO2	develop basic skills in design of simple AVR microcontroller based embedded systems