Programme Outcome of B. Sc. Physics

At the completion of B. Sc. in Physics students are able to:

PO 1: Demonstrate a rigorous understanding of the core theories & principles of physics, which includes mechanics, electromagnetism, thermodynamics, & quantum mechanics.

PO 2: Learn the Concepts as Quantum Mechanics, Relativity, introduced at degree level in order to understand nature at atomic levels.

PO 3: Provide knowledge about material properties and its application for developing technology to ease the problems related to the society.

PO 4: Understand the set of physical laws, describing the motion of bodies, under the influence of system of forces.

PO 5: Understand the relationship between particles & atom, as well as their creation & decay.

Relate the structure of atoms & subatomic particles

PO 6: Understand physical properties of molecule the chemical bonds between atom as well as molecular dynamics.

PO 7: Analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

PO 8: Learn the structure of solid materials & their different physical properties along with metallurgy, cryogenics, electronics, & material science.

PO 9: Understand the fundamental theory of nature at small scale & levels of atom & sub-atomic particles.

Course Outcomes

Title of Paper- METHODOLOGY OF SCIENCE AND PHYSICS

Course Code- PH1 B01

Credits 2

Total Hours 36

This course provides the student with

- A general idea about what is science, what is scientific temper,history of science and scientific revolutions
- Familiarity with the different steps involved in the scientific method with the help of a flow chart, explaining what is hypothesis and how they become scientific laws
- Awareness of a brief history of physics, giving emphasis on the birth of quantum theory using black body radiation, photoelectric , X rays and DeBroglie waves and a general idea about theory of relativity
- Introduction to mathematical methods physicists often use, including differential Calculus,The operator - Gradient, Divergence, Curl, integral calculus, matrices and curvilinear coordinates

Title of Paper- PROPERTIES OF MATTER, WAVES & ACOUSTICS

Course Code PH2 B02

Credits 2

Total Hours 36

After successful completion of the course, the student is expected to

- Learn the basics of properties of matter, how Young's modulus and rigidity modulus are defines and how they are evaluated for different shapes of practical relevance
- Learn the fundamentals of harmonic oscillator model, including damped and forced oscillators and grasp the significance of terms like quality factor and damping coefficient
- Study the general equation of wave motion in general and TM waves in stretched strings and

longitudinal waves in gases

- Familiarise with general terms in acoustics like intensity, loudness, reverberation etc, and study in detail about production, detection, properties and uses of ultrasonic waves.

Title Of Paper- MECHANICS
Course Code- PH3 B03
Credits 4
Total Hours 56

On successful completion of the course students would have

- Grasped the fundamentals of different types of frames of references and transformation laws- Both Galilean and Lorentz
- Learned conservation laws of energy and linear and angular momentum and apply them to solve problems
- Learn the basics of potentials and fields, central forces and Kepler's laws
- Familarise with Lagrangian and Hamiltonian formulations of classical mechanics
- Fundamental ideas of special theory of relativity such as length contraction and time dilation and mass –energy invariance

Title Of Paper- ELECTRODYNAMICS I
Course Code- PH4B04
Credits 4
Total Hours 54

After successful completion of the course, the student is expected to :

- Have gained elaborated knowledge about electrostatics and laws governing the charge distribution
- Have gained ability to apply Laplace equation for calculating potentials.
- Study in depth about Polarization, bound charges and boundary condition.
- To realize the importance of application of Biot Savarts Law and Amperes law.
- To understand the relevance of different magnetization and the boundary condition of magnetic field.

Title of the paper ELECTRODYNAMICS II
Course Code PH5B06
Credits 3
Total Hours 54

After successful completion of the course, the student is expected to :

- be able to solve a variety of problems related to Faraday's law of induction and Maxwell's equations. Student is expected to explain term displacement current as well.
- understand the relevance of displacement current in the context of electromagnetic wave propagation.
- study in depth the transient current response of CR, LC, CR and LCR circuits, which is essential in designing as well as understanding the working of electronic circuits.
- solve complex problems involving linear electrical networks employing the symmetry concepts together withvarious network theorems

Title of the paper QUANTUM MECHANICS
Course Code PH5 BO7
Credits 3
Total Hours 54

After successful completion of the course, the student is expected to:

- To become familiar with Blackbody radiation, Ultraviolet catastrophe,PhotoElectric effect and Compton Effect and hence be aware how quantum theory emerged
- Have gained a clear knowledge about wave properties of particles,De Broglie waves and its

implications on theuncertainty principle.

- Study the Bohr Atom model in detail and understand about atomic excitations
- Have grasped the idea of Wave Mechanics and gain the concept of eigen values, eigen functions and learn the basic postulates of quantum mechanics
- To find solution to Schrödinger's equation for many systems such as particle in a box, Hydrogen Atom and familiarize with different quantum numbers.

Title of the paper PHYSICAL OPTRICS AND MODERN OPTICS
Course Code PH5BO8
Credits 3
Total Hours 54
On successful completion of the course students will be able to:

- Understand the basics of the Matrix method to solve problems of geometrical optics
- Use the principles of wave motion and superposition to explain the physics of polarisation, interference and diffraction.
- Understand the basics of modern optics like Fiber optics and holographyC04. Solve problems in optics by selecting the appropriate equations and performing numerical or analytical calculations.

Title of the paper ELECTRONICS (ANALOG & DIGITAL)
Course Code PH5BO9
Credits 4
Total Hours 72
After successful completion of the course, the student is expected to

- have a basic knowledge of semiconductor physics
- acquire knowledge about how a semiconductor diode rectifies an input ac signal
- Learn how to construct a transistor amplifier and how its gain varies with frequency
- know about various number systems and their applications , flip flops and counters

Title of the paper THERMAL AND STATISTICAL PHYSICS
Course Code PH5B10
Credits 4
Total Hours 72
After successful completion of the course, the student is expected to

- Become familiar with various thermodynamic process and work done in each of these process.
- Have a clear understanding about Reversible and irreversible process and also working of a Carnot engine, and knowledge of calculating change in entropy for various process.
- Realize the importance of Thermo dynamical functions and applications of Maxwell's relations.
- Familiarize in depth about statistical distribution and have basic Ideas about Maxwell-Boltzman, Bose-Einstein and Fermi Dirac Statistics and their applications

Title of the paper SOLID STATE PHYSICS,SPECTROSCOPY AND LASER PHYSICS
Course Code PH6B11
Credits 4
Total Hours 72
After successful completion of the course, the student is expected to :

- Have a clear picture of crystal structures and a clear understanding about x-ray diffraction
- Expected to gain knowledge of superconductivity,,its underlying principles and its applications in modern world
- Become familiar with molecular spectroscopy and have gained basic ideas regarding microwave spectroscopy, infrared spectroscopy and Raman Spectroscopy.
- Have gained basic knowledge of laser and working of different type of lasers

Title of the paper NUCLEAR PHYSICS, PARTICLE PHYSICS AND

ASTROPHYSICS
Course Code PH6B12
Credits 4
Total Hours 72
After successful completion of the course, the student is expected to :

- Gain a clear picture of nuclear composition and various nuclear models.
- Have a deep knowledge about Radio activity,nuclear Fission and Nuclear Fusion,the relevance of nuclear transformation.
- Understand the working of nuclear detectors and counters,realize the importance of Cosmic rays and its effects on earth
- Become familiar with nuclear particles and different particle accelerators. Student is expected to know the working of different accelerators.
- Have Peripheral ideas about astronomy and astrophysics

OPEN COURSES OFFERED BY PHYSICS DEPARTMENT

Objective

To develop scientific temper and attitude in students from other streams.

Title of the paper- NON CONVENTIONAL ENERGY SOURCES
Course Code- PH5 DO1 (1)
Credits 2
Total Hours 50
Since the course does not require a solid base in physics, the student is only expected to develop

- Qualitative ideas about Solar energy, Physical principle of conversion of solar energy into heat energy, solar energy harvesting devices like solar cells, solar cookers, solar greenhouses etc
- Gets an idea about basic principle of wind energy conversion and basic components of wind energy conversion systems
- Elementary idea of Geothermal energy sources, its applications and method of obtaining energy from biomass
- Know about other non-conventional energy sources like Ocean Thermal Energy Resources, Wind energy and Chemical energy resources

M.Sc. Physics Programme Outcome

The Master of Science in Physics programme provides the candidate with knowledge, general competence, and analytical skills on an advanced level, needed in industry, consultancy, education, research, or public administration.

This programme gives special expertise within the research areas like Astro and Particle Physics and Modern Field Theory, Biophysics, Energy and Environmental Physics, Optics and Condensed Matter Physics.

Knowledge

The candidate

- has substantial knowledge in physics, basic knowledge in mathematics, and knowledge in supported fields like computer science.
- has some research experience within a specific field of physics, through a supervised project .

- has advanced knowledge in some areas in physics.
- is familiar with contemporary research within various fields of physics.

Skills

The candidate

- has the background and experience required to model, analyse, and solve advanced problems in physics.
- is able to apply advanced theoretical and/or experimental methods, including the use of numerical methods and simulations.
- can combine and use knowledge from several disciplines.
- can critically and independently assess and evaluate research methods and results.
- has the ability to develop and renew scientific competence
- is able to enter new problem areas that require an analytic and innovative approach.
- can disseminate subject matter and results to both specialists and a broader audience.
- Become professionally trained in the area of electronics, optical communication, nonlinear circuits, materials characterization and lasers.

General competence

The candidate

- understands the role of physics in society and has the background to consider ethical problems.
- knows the historical development of physics, its possibilities and limitations, and understands the value of lifelong learning.
- is able to gather, assess, and make use of new information.
- has the ability to successfully carry out advanced tasks and projects, both independently and in collaboration with others, and also across disciplines.
- has an adequate background for pursuing pedagogic education.
- has an international perspective on her/his discipline.

MSc Physics - Course Outcomes

Title of the paper - CLASSICAL MECHANICS
Course Code -PHY1C01
Credits 4
Total Hours 62
This paper enables the students to understand

- TheLagrangian and Hamiltonian approaches in classical mechanics.
- The classical background of Quantum mechanicsand get familiarized with Poisson brackets and Hamilton -Jacobi equation
- Kinematics and Dynamics of rigid body in detail and ideas regarding Euler's equations of motion
- Theory of small oscillations in detail along with basis of Free vibrations.
- Basic ideas about Non linear equations and chaos.

Title of the paper -MATHEMATICAL PHYSICS
Course Code -PHY1C02
Credits 4

Total Hours 60

In this course the student will

- Learn about Gradient, Divergence and Curl in orthogonal curvilinear and their typical applications in physics.
- Learn about special type of matrices that are relevant in physics and then learn about tensors.
- Get introduced to Special functions like Gamma function, Beta function, Delta function, Dirac delta function, Bessel functions and their recurrence relations
- Learn different ways of solving second order differential equations and familiarized with singular points and Frobenius method.
- Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms,their inverse transforms etc

Title of the paper - ELECTRODYNAMICS AND PLASMA PHYSICS
Course Code -PHY1C03
Credits 4
Total Hours 60

After successful completion of the course, the student is expected to :

- have gained a clear understanding of Maxwell's equations and electromagnetic boundary conditions.
- know that laws of reflection, refraction are outcomes of electromagnetic boundary conditions. They will also be able design dielectric coatings which act like antireflection coatings. They will be able to distinguish between a good metal and a good dielectric.
- have grasped the idea of electromagnetic wave propagation through wave guides and transmission lines.
- extend their understanding of special theory of relativity by including the relativistic electrodynamics.
- understand the rather complex physical phenomena observed in plasma.

Title of the paper - ELECTRONICS
Course Code- PHY1C04
Credits 4
Total Hours 62

On completion of this course the student will learn about

- Field Effect Transistors, their principles and applications
- Photonic devices like LED, Laser diode, photodetectors, solar cells etc and their working in detail
- Basic operational amplifier characteristics, OPAMP parameters ,applications as inverter, integrator, differentiator etc
- Digital electronics baiscsusing logic gates and working of major digital devices like flip flops, CMOS ,CCD etc
- Karunaghmaps,flipFlops,counters and working of Microprocessor in detail.

Title of the paper -QUANTUM MECHANICS 1
Course Code -PHY2 C05
Credits 4
Total Hours 60

After successful completion of this paper, the student will be well-versed in

- Linear vector spaces, Hilbert space, concepts of basis and operators and bra and ket notation
- Both schrodinger and Heisenberg formulations of time development and their applications
- Theory of angular momentum and spin matrices, orbital angular momentum and

ClebshGordan Coefficient

- Space-time symmetries and conservation laws, theory of identical particles
- Theory of scattering and calculation of scattering cross section, optical theorem ,Born and Elkonal approximation, partial wave analysis etc.

Title of the paper -MATHEMATICAL PHYSICS - II
Course Code- PHY2C06
Credits 4
Total Hours 60

After successful completion of the course, the student is expected to :

- know the method of contour integration to evaluate definite integrals of varying complexity.
- have gained ability to apply group theory to physics problems, which is a pre-requisite for deeper understanding of crystallography, particle physics, quantum mechanics and energy bands in solids.
- be able to apply calculus of variations to diverse problems in physics including isoperimetric problems.
- to become familiar with the method of Green's function to solve linear differential equations with inhomogeneous term
- to find solutions to integral equations using different methods.

Title of the paper -STATISTICAL MECHANICS
Course Code- PHY2 CO7
Credits 4
Total Hours 50

The students should be able to

- Explain statistical physics and thermodynamics as logical consequences of the postulates of statistical mechanics
- Apply the principles of statistical mechanics to selected problems
- Grasp the basis of ensemble approach in statistical mechanics to a range of situations
- To learn the fundamental differences between classical and quantum statistics and learn about quantum statistical distribution laws
- Study important examples of ideal Bose systems and Fermi systems

Title of the paper -COMPUTATIONAL PHYSICS
Course Code- PHY2 CO8
Credits 4
Total Hours 60

The students should be able to,

- .Have a strong base in Python language regarding different data type such as list,sets,dictionary etc.
- It helps to understand the different modules like NUMPY, Matplotlibetc
- Understand Arrays and matrices and enables data visualization
- Gets a wide knowledge of numerical methods in computational Physics that can be used to solve many problems which does not have an analytic solution
- Solve problems in physics such as standing waves, central field motion, Kirchoffs law etc using python language.

Title of the paper -QUANTUM MECHANICS 2
Course Code -PHY2 CO9
Credits 4
Total Hours 64

This course will enable the student to have basic knowledge about advanced techniques like

- Approximation methods for time-independent problems like the WKB approximation
- The variational equation and its application to ground state of the hydrogen and Helium atom
- Perturbation theory and Interaction of an atom with the electromagnetic field
- Relativistic Quantum Mechanics using Dirac equation, Dirac matrices,. The Klein Gordon equationetc
- Second quantization of the Schrödinger wave field for bosons and fermions

Title of the paper- NUCLEAR AND PARTICLE PHYSICS
Course Code- PHY 3C10
Credits 4
Total Hours 60

After successful completion of the course, the student is expected to

- have a basic knowledge of nuclear size ,shape , bindingenergy.etc and also the characteristics of nuclear force in detail.
- be able to gain knowledge about various nuclear models and potentials associated.
- acquire knowledge about nuclear decay processes and their outcomes. Have a wide
- understanding regarding beta and gamma decay.Grasp knowledge about Nuclear reactions, Fission and Fusion and their characteristics.
- understand the basic forces in nature and classification of particles and study in detail conservations laws and quark models in detail

Title of the paper- SOLID STATE PHYSICS
Course Code PHY3C11
Credits 4
Total Hours 64

After successful completion of the course, the student is expected to

- have a basic knowledge of crystal systems and spatial symmetries ,- be able to account for how crystalline materials are studied using diffraction, including concepts like reciprocal lattice and Brillouin zones
- know what phonons are, and be able to perform estimates of their dispersive and thermal properties , be able to calculate thermal and electrical properties in the free-electron model
- know Bloch's theorem and what energy bands are and know the fundamental principles of semiconductors
- know the fundamentals of dielectric and ferroelectric propertiesof materials
- know basic models of dia, para and ferro magnetism
- be able to explain superconductivity using BCS theory

Title of the paper -EXPERIMENTAL TECHNIQUES OF MODERN PHYSICS
Course Code -HY3 E07
Credits 4
Total Hours 62

After successful completion of the course, the student is expected to :

- Have gained a clear understanding of different vacuum pumps and the production and
- maintenance of vacuum systems and its uses and needs in PhysicUnderstands in depth about thin film preparation and production controlling techniques and the application of thin films in the field of science & Technolog
- Have grasped the idea of Cryogenics technology and its application.
- Extend their understanding of various particle accelerators and its industrial uses.
- understand about different material analysis techniques and applications.

Title of the paper- ATOMIC & MOLECULAR SPECTROSCOPY
Course Code- PHY4C12
Credits 4
Total Hours 61
After successful completion of the course, the student is expected to :

- know about different atom model and will be able to differentiate different atomic systems, different coupling schemes and their interactions with magnetic and electric fields.
- Have gained ability to apply the techniques of microwave and infrared spectroscopy to elucidate the structure of molecules
- Be able to apply the principle of Raman spectroscopy and its applications in the different field of science & Technology.
- To become familiar with different resonance spectroscopic techniques and its applications
- to find solutions to problems related different spectroscopic systems.

Title of the paper –LASERS AND FIBRE OPTICS
Course Code - PHY4E13
Credits 4
Total Hours 61
This elective course helps to understand optical fibres which are vital in the field of communication and laser techniques used in various research studies. After successful completion of the course, the student is expected to

- have an idea about basic laser theory, Einstein coefficients, Light amplification and optical resnators
- have information about different types of lasers,holography and second harmonic generation
- have a fair idea of different types of optical fibres.
- have a comprehensive awareness of the the losses in optical fibres.
- Know about the measurement techniques in optical fibres.

Title of the paper- MICROPROCESSORS AND APPLICATION
Course Code -PHY4E20
Credits 4
Total Hours 60
The student who opt this elective will

- Study the Organization and internal architecture of the Intel 8085,
- learn assembly language programming and arithmetic
- Aware of Memory interfacing, and different Data transfer schemes, CO4
- Learn interfacing with peripheral I/O devices
- Learn common applications of microprocessors like E Analog to Digital convert,7 segment LED displays,; Temperature measurement and control using a microprocessor etc