PHYSICS PG SELF FINANCING

Course Outcomes

The M.Sc. Physics program has 20 courses offered in Physics during 4 semesters. Five Courses are offered in each of the four semesters. The course outcomes of the different courses are stated here.

SEMESTER - I

PH1CO1 MATHEMATICAL METHODS IN PHYSICS – I

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.

PH1C02 CLASSICAL MECHANICS

This paper enables the students to understand

- The Lagrangian and Hamiltonian approaches in classical mechanics.
- The classical background of Quantum mechanics and 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.

PH1C03 ELECTRODYNAMICS

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.

PH1C04 ELECTRONICS

On completion of this course the student will learn about

- Field Effect Transistors, their principles and applications
- Basic operational amplifier circuits.
- Different Communication Systems.

SEMESTER – II

PH2C05 MATHEMATICAL METHODS IN PHYSICS – II

In this course the student will

- Learn the fundamentals and applications of Fourier series, Fourier and Laplace transforms, their inverse transforms etc.
- 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.

PH2C06 QUANTUM MECHANICS – I

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 Schrödinger and Heisenberg formulations of time development and their Applications.
- Theory of angular momentum and spin matrices, orbital angular momentum and Clebsh Gordan Coefficient.
- Space-time symmetries and conservation laws, theory of identical particles.

PH2C07 THERMODYNAMICS AND STATISTICAL MECHANICS

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.

PH2C08 CONDENSED MATTER PHYSICS

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 properties of materials
- know basic models of dia, para and ferro magnetism
- be able to explain superconductivity using BCS theory

SEMESTER – III

PH3C09 QUANTUM MECHANICS – II

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 equation etc.
- Second quantization of the Schrödinger wave field for bosons and fermions.

PH3C10 COMPUTATIONAL PHYSICS

- *The students should be able to* 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.

PH3EC1 SOLID STATE PHYSICS

This elective course gives the student

- An idea about all types of crystal defects and dislocations.
- Information about Phase diagrams and general diffusion theory in detail.
- Knowledge about laser.

PH3EC2 CRYSTAL GROWTH TECHNIQUES

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

- Acquire knowledge about various crystal growth techniques.
- Have information about materials used to fabricate various semiconductor devices.

SEMESTER - IV

PH4C11 ATOMIC AND MOLECULAR PHYSICS

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.

PH4C12 NUCLEAR AND PARTICLE PHYSICS

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.

PH4EC3 NANOSTRUCTURES AND CHARACTERIZATION

This course will enable the student to have basic knowledge about

- Preparation of quantum nanostructures, Microelectromechanical Systems and Nanoelectrochemical systems.
- Carbon nanotubes and their applications.
- Thermal, Microscopic and Infrared analysis.
- Mass spectroscopy and Resonance spectroscopy.

PH4OE1: OPTOELECTRONICS

In this course the student will

- Learn about structure and working of LED.
- Understand the propagation of light wave in dielectric wave guide
- Have idea about importance of optical fibers in communication systems.

- Learn the working of photo detectors like photodiodes, phototransistors and photovoltaic devices
- Learn elementary ideas of non linear optics.

Practical Papers

There are four practical papers in the M.Sc. Physics Programmme.

- **PH1P01 GENERAL PHYSICS PRACTICALS – Semester 1**
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- **PH2P02 ELECTRONICS PRACTICALS – Semester 2**
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- **PH3P03 COMPUTATIONAL PHYSICS PRACTICALS – Semester 3**
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- **PH4PC4 MATERIAL SCIENCE PRACTICALS – Semester 4**

These practical papers make the student familiar with General physics experiments like Cornu's method, Quincke's method, Photoelectric effect etc. Students will be expertise in handling specific electronic equipments like CRO, function generators etc.

Here practicals in computational physics are performed using C++ language which will give a new experience to the students in the field of computer simulations. In their material science students will learn to analyze XRD spectrum, U-V spectrum etc.