# ACHARYA INSTITUTE OF GRADUATE STUDIES

**(NAAC Re-Accredited 'A' Grade & Affiliated to Bengaluru City University)**

**Soladevanahalli, Bengaluru-560107**

**DEPARTMENT OF PHYSICS**

**NAME OF THE PROGRAM: MASTER OF SCIENCE IN PHYSICS**

## COURSE OUTCOMES (CO'S)

### CLASSICAL MECHANICS
### (Both Theory and Practical)

After undertaking the course, the students will be able to ,

- Theoretically use the laws of motion and their application to various dynamical situations, notion of inertial frames and concept of Galilean, Lorentzian, Lagrangian and Hamiltonian invariance. They will learn the concept s of conservation of energy, momentum, angular momentum and apply them to basic problems.

- In the laboratory course, the student shall perform hands on experiments related to mechanics (Simple and compound pendulum), rotational dynamics (Searle Bar and Flywheel), elastic properties (Young Modulus and Modulus of Rigidity) and fluid dynamics (verification of Stokes law, Searle method) etc.

### ELECTRODYNAMICS & ELECTROMAGNETISM
### (Both Theory and Practical)

After undertaking the course, the students will be able to ,

- Demonstrate Gauss law, Coulomb's law for the electric field, and apply it to systems of point charges as well as line, surface, and volume distributions of charges.

- Demonstrate eloquent knowledge of electric current, resistance and capacitance in terms of electric field and electric potential.

- In the laboratory course the student will get an opportunity to verify various laws in electrodynamics and electro magnetism such as Lenz's law, Faraday's law and learn about the construction, working of various measuring instruments.

**QUANTUM MECHANICS**
**(Both Theory and Practical)**

After undertaking the course, the students will be enabled to,

- Investigate on the basis of the exposition of inadequacies of classical mechanics in explaining microscopic phenomena using quantum theory formulation through Schrodinger equation.

- Articulate the influence of electric and magnetic fields on atoms and molecules which will help in demonstrating Stark effect and Zeeman Effect experiments respectively.

- In the laboratory course, with the exposure in computational and numerical programming skills, the students 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.

**STATISTICAL MECHANICS**
**(Both Theory and Practical)**

After undertaking the course, the students will be enabled to,

- Report and verify the concepts of microstate, macro -state, ensemble theory, phase space, thermodynamic probability and partition functions.

- Demonstrate the combinatory studies of particles with their distinguishable or indistinguishable nature and their conditions which lead to the three different distribution laws as givenby, Maxwell -Boltzmann distribution, Bose -Einstein distribution and Fermi -Dirac distribution laws of particles and their derivation.

- In the laboratory course, the students get an opportunity to verify Stefan's Law of radiation and determine Stefan's constant.

**EXPERIMENTAL TECHNIQUES**

After undertaking the course, the students will be enabled to,

- Distinguish between accuracy and precision and learn different types of errors and statistical analysis of data.

- Conversant about Noise and signal, signal to noise ratio, different types of noises and their Identification.

- Generate skills in demonstrating the concept of electromagnetic interference, use and necessity of grounding, working of a digital multimeter, Vacuum systems including ultrahigh vacuum systems.

- Conduct Experiments using different transducers including LVDT and gain hands on experience and verify the underlying theory.

**MATHEMATICAL PHYSICS-I &II**

After undertaking the course, the students will be enabled to,

- Comprehend the basic properties of the linear vector space such as linear dependence and independence of vectors, change of basis, isomorphism and homomorphism, linear transformations and their representation by matrices

- Comprehend the basic properties of matrices, different types of matrices viz., Hermitian, skew Hermitian, orthogonal and unitary matrices and their correspondence to physical quantities, e.g., operators in quantum mechanics. They should also learn how to find the eigen values and eigenvectors of matrices.

- Comprehend some basic properties tensors, their symmetric and anti -symmetric nature, the Cartesian tensors, the general tensors, contra-variant, covariant and mixed tensors and their transformation properties under coordinate transformations, physical examples of tensors such as moment of inertia tensor, energy momentum tensor, stress tensor, strain tensor etc.

- In the laboratory course, the students are expected to solve the numerical problems using the C++ computer language.

**NUCLEAR & PARTICLE PHYSICS**
(Both Theory and Practical)

After undertaking the course, the students will be enabled to,

- Comprehend the ground state properties of a nucleus – the constituents and their properties, mass number and atomic number, relation between the mass number and the radius and the mass number, average density, range of force, saturation property, stability curve, the concepts of packing fraction and binding energy, binding energy per nucleon vs. mass number graph, explanation of fusion and fission from the nature of the binding energy graph.

- Eloquent knowledge on the basic aspects of particle Physics – the fundamental interactions, elementary and composite particles, the classifications of particles: leptons, hadrons (baryons and mesons), quarks, gauge bosons.

- The students should know about the quantum numbers of particles: energy, linear momentum, angular momentum, iso -spin, electric charge, colour charge, transgeneses, lepton numbers, baryon number and the conservation laws associated with them

- In the laboratory course, they learn about the detectors of nuclear radiations -the Geiger -Mueller counter, the scintillation counter, the photo - multiplier tube, the solid state and semiconductor detectors .

**ASTRONOMY AND ASTROPHYSICS**
**(Both Theory and Practical)**

After undertaking the course, the students will be enabled to,

- Comprehend astronomical scales and learn basic concepts of positional astronomy like astronomical coordinate system and measurement of distances, time and temperature and radius of star.

- Acquire basic knowledge of galaxies and Milky Way. Morphology and classification of galaxies, intrinsic stages of galaxies, galactic halo, milky way, gas and dust in galaxy, spiral arm, rotation of galaxy and dark matter. Star clusters in Milky Way, galactic nucleus and its properties.

- In the laboratory course, the students are expected to solve the Astronomical problems using computer programming methods.

**NANO MATERIALS AND APPLICATIONS**
**(Both Theory and Practical)**

After undertaking the course, the students will be enabled to,

- Comprehend the concept of Quantum confinement, 3D, 2D, 1D and 0D nanostructure with examples .
- Comprehend different synthesis techniques including top down and bottom-up approaches.
- Trained to characterize nano-structured materials using X-ray diffraction, electron microscopy, Atomic Force Microscopy and Scanning Tunneling Microscopy.
- Demonstrate applications of nano -structured materials in making devices namely MEMS, NEMS and other hetero-structures for solar cell and LEDs .
- In the laboratory course, the students are expected to synthesize nano - particles by different chemical routs and characterize them in the laboratory using the different techniques he has learnt in the theory. He will also carry out thin film preparation and prepare capacitors and evaluate its performance. They also expected to fabricate a PN diode and study its I -V characteristics.

**SOLID STATE PHYSICS**
**(Both Theory and Practical)**

After undertaking the course, the students will be enabled to,

- Trained to analyze crystalline and amorphous substances, about lattice, unit cell, miller indices, reciprocal lattice, and concept of Brillouin zones and diffraction of X-rays by crystalline materials.
- Attain knowledge of different types of magnetism from diamagnetism to ferromagnetism and hysteresis loops and energy loss.
- In the laboratory course, the students are expected to 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.

**ELECTRONICS AND INTEGRATED CIRCUITS**
**(Both Theory and Practical)**

After undertaking the course, the students will be enabled to,

- Recognize a variety of exciting high -tech products and systems enabled by electronics.
- Illustrate voltages, currents and resistances in electronic circuits.
- Demonstrate familiarity with basic electronic components and use them to design simple electronic circuits .
- Visualize how signals can be represented in the time and frequency domains for Fourier analysis .
- In the laboratory course, the students are expected to build different types of electrical circuits, record and analyze their electrical responses and filter audio / video signals to improve their fidelity