Program Name: **M. Sc. Physics**

Program specific Outcomes

A student completing this program will:

PSO1: have fundamental and advanced level knowledge in field of nuclear and particle physics particularly plasma and fusion reactor, nuclear accelerator and radiation physics together with their applications in solving complex scientific problems in astrophysics, cosmology and general theory of relativity.

PSO2: have fundamental and advanced level knowledge in field of electronics particularly optical fiber communication, nanoelectronics, VLSI design, optoelectronics, control systems, microprocessor and microcontrollers together with their applications in interdisciplinary areas of science.

PSO3: have fundamental and advanced level knowledge in field of material science particularly thin film physics, laser and photonics, Fundamentals of micro and nanofabrication together with their applications in materials processing for advanced applications.

Course outcomes for all courses offered by the department:

Semester	Course code	Course name	Course Outcomes Student completing this course is able to
1	PPH-1801	Mathematical Physics-1 & Quantum Mechanics -1	1: Use of Fourier transforms and its inverse in practical applications of Physics, apply Laplace transform and its inverse to solve initial value and other related problems. 2: Demonstrate good understanding of basic concepts in group theory, Demonstrate good understanding of various types tensor and will develop basic skills to do tensor algebra 3: Decide whether a given group is cyclic, and given a finite cyclic group, find a generator for a subgroup of a given order, Express a given finite cyclic group as the direct product of cyclic groups of prime power order and, given two direct products of cyclic groups, determine whether or not they are isomorphic 5: Express products of elements of a group defined by generators and relations in appropriate standard form, Understand concept of tensor variables and difference from scalar or vector variables. 6: Understand the reason why the tensor analysis is used and explain usefulness of the tensor analysis, Clarify the basic concepts of

			perturbation and describe nondegenerate energy levels. 7: Explain first order and second order correction to energy and wave function, Give an example of Anharmonic oscillator and compute first order correction to energy. 8: Investigate the ground state of hydrogen atom and determine the first order correction to energy, Describe Stark effect and calculate the second order energy shift. 9: Interpret spin orbit interaction, derive base vectors, metric tensors and strain tensors in an arbitrary coordinate system. 10: Quantum mechanical axioms and the matrix representation of quantum mechanics, apply the variational method and time-independent perturbation theory to solve simple problems 11: Will be able to solve the numericals of the above mentioned concepts and theory
1	PPH-1802	Analog Electronics	1: Learn the characteristics of an ideal OPAMP and practical OPAMP. 2: Do analysis of inverting and non-inverting amplifier including different applications of OPAMP through numerical 3 Design and analyse the integrator and differentiator circuit and will solve the linear equation through OPAMP circuits 4: Describe function of each components in Transformer coupled Amplifier, class- A, B, and AB push pull power amplifier. 5: Design the Transformer coupled amplifier, class- A, B, and AB push pull power amplifier and also design Multivibrators 6: Describe the basic principles of complimentary push pull amplifier. 7: Understand the working of 3 terminal and 4 terminal voltage regulator circuits 8: Learn the basics and application of some of the Thyristor family devices 9: Learn depletion and enhancement type of MOSFET, Including the difference between JFET and MOSFET. 10: Understand and learn TTL logic family, CMOS, Gates and interfaces among TTL and CMOS
1	PPH-1803	Numerical methods and Computer programming in C	1: Apply numerical methods to obtain approximate solutions to mathematical problems.

			2: Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations. 3: Understanding of Monte-Carlo evaluation of integrals and error and apply in numerical methods. 4: Analyse and evaluate the accuracy of common numerical methods. 5: Implement numerical methods in C Language 6: Be able to perform Monte-Carlo simulations of simple systems, 7: Able to develop C programs. 8: Ability to design and develop Computer programs, analyse, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage. 9: Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures. 10: Develop confidence for self-education and ability for life-long learning needed for Computer language.
1	PPH-1804	Solid State Physics	1: Understand Bloch's theorem and what energy bands are and know the fundamental principles of semiconductors 2: Explain the formation of energy band and classify metals, semiconductors and insulators, understand different models and methods like the nearly free electron model, Tight binding approximation, Wigner-Seitz cellular method and Pseudopotential method. 3: Describe Fermi Surface, its construction and will be able to apply it to study the heat capacity, electrical conductivity and thermal conductivity of the material. 4: Distinguish monovalent, divalent, trivalent and tetravalent Fermi surfaces and its characteristics, Describe the electric and magnetic field on Fermi surfaces. 5: A detailed discussion on ferromagnetism and anti-ferromagnetism that make students enable to describe few models like Weiss molecular theory for ferro, hysteresis, and classifications of soft and hard material on that basis. 6: Students can also explain Heisenberg spin and exchange interaction in ferromagnetism super exchange in anti-ferromagnetism

			7: Define superconductivity and give a qualitative description of all properties including Meissner effect 8: Show how the London equations and Maxwell's equations lead to the prediction of the Meissner effect. 9: Apply London theory and Ginzburg-Landau theory for superconductivity for type-I and type-II superconductivity based on thermodynamic calculations of the Gibbs free energy for a superconductor 10: Discuss the fundamental theories of superconductivity and their application
1	PPH-1805L	Electronics Laboratory	1: Will be able to demonstrate the OPAMP parameters. 2: Will be able to demonstrate the OPAMP as inverting or non-inverting amplifiers. 3: Will be able to demonstrate the OPAMP as Voltage to Current and Current to Voltage Converter. 4: Will be able to demonstrate the OPAMP as an Integrator. 5: Will be able to demonstrate the OPAMP as a differentiator. 6: Will be able to demonstrate the Voltage regulator using OPAMP. 7: Will be able to demonstrate the OPAMP as an adder and subtractor. 8: Will be able to demonstrate 5V regulated power supply using three terminal IC 9: Will understand the application of OPAMP and practical use. 10: Will be ready to design the circuit using OPAMP characteristics.
1	PPH-1806L	Physics Laboratory	1: Will be able to measure the speed of the sound wave using CRO 2: Will be able to determine the specification rotation of sugar solution using Polari meter 3: Will be able to measure surface tension of liquid using surface wave 4: Will be able to measure dielectric constant of a non-polar liquid 5: Will be able to measure the energy band gap, voltage coefficient and diffusion capacitance of the PN junction diode. 6: Will be able to measure the resistivity using four probe. 7: Will be able to run scripts in “C” Programming.

			8: Will be able to do numerical methods using "C" programming 9: Will understand the application and importance of "C" programming. 10: Will be able to explain importance of physics practical.
2	PPH-2801	Digital Electronics & Microprocessors	1: Understand 1-bit memory element, learn truth table, excitation table and FSM of different type of flip-flop. 2: Design/convert the flip-flop. 3: Learn application of flip flop as a shift register. 4: Understand working of SISO, SIPO, PIPO and PISO registers. 5: Get information about 555 timer IC. 6: Designing the different type of multivibrator using 555 IC. 7: Study different types of digital counter in detail. Also learn the synchronous and asynchronous counters 8: Study various types of digital to analog converters and analog to digital converters. 9: Study basic working and functioning of microprocessor 8085, with its organization and architecture. 10: Also perform some of the basic programming of microprocessor with additional instruction sets.
	PPH-2802	Electrodynamics	1: Understand different conservation laws. 2: Solve problems of electromagnetic waves and wave propagation. 3: Describe the nature of electromagnetic wave and its propagation through different media and interfaces. 4: This unit is aims to teach advance formulation of retarded scalar and vector potentials for generalized description of electromagnetic fields originating from moving and accelerating point charges. 5: Understand the concept of dipole radiation and its application to design and optimize the antenna properties. 6: Describe the concept of electromagnetic waves radiation for electric and magnetic dipole moment. 7: Understand the relativity concepts of electrodynamics, and discussion of Lienard Wiechert potential. 8: Understand and analyse the electrical quadruple and amount of total power radiation transmitted

			for different cases like arbitrary source and point charges. 9: This unit introduces students with concept of scattering of electromagnetic waves by dipoles, dielectric spheres and many other media with applications. 10: Understand the scattering and dispersion in detail and perturbation theory of scattering. 11: Solve the problems of the above mentioned concepts and theory
2	PPH-2803	Classical Mechanics And Statistical Mechanics	1: To demonstrate knowledge and understanding of the fundamental concepts in Lagrangian and Hamiltonian formulation of mechanics 2: To represent the equations of motion for complicated mechanical systems using the Lagrangian and Hamiltonian formulation of classical mechanics. 3: To be familiar with the foundations of Theoretical Physics. 4: Will be able to demonstrate good understanding of fluctuations, its power spectrum and will be able to apply it to study various types of noise. 5: Will be able to demonstrate good understanding of critical phenomena occurring at phase transition. 6: Have a basic understanding of the phase transitions, 7: Have a deep understanding of universality in second order phase transitions. 8: Will be familiar with order of phase transition and Clusius-Clayperon equation. 9: Understanding of Curie-Weiss theory of Magnetic transition. 10: Will be able to demonstrate Ising Model in zeroth approximation.
2	PPH-2804	Atomic ,Molecular and Laser Physics	1: Identify many electron atoms and one electron atoms 2: Set up the radial equation and describe the variation of effective potential against distant (r) for a coulomb potential. 3: Apply Schrodinger equation to Hydrogen like atom to obtain energy eigen value and wave functions. 4: Find radial probability density and compute the probability of finding the electron of hydrogen atom at a certain distance from the nucleus. 5: Sketch the polar representation of spherical harmonics of hydrogen atom, use Viral theorem to obtain expectation value of potential energy and kinetic energy

			6: Outline the hydrogen like atoms, find orbitals of a hydrogen atom and probability density. 7: The interaction between atoms, molecules and electromagnetic fields, the structure of the periodic system, many-electron and relativistic effects. 8: About fundamental of Nuclear Magnetic Resonance, measurement of NMR spectra and its interpretation, hardware, experimental methods, equivalent theoretical description and its applications like NMRI in daily life. 9: Describe the requirements for a system to act as a laser. 10: Differentiate the various types of lasers and their means of excitation, relate the structure and properties of lasers to their performance and intended applications.
2	PPH-2805L	Electronics Laboratory	1: Will be able to demonstrate the active filters using OPAMP. 2: Will be able to demonstrate the Wien Bridge Oscillator using OPAMP. 3: Will be able to demonstrate the Digital Design using Karnaugh Map. 4: Will be able to demonstrate the Digital Design using Multiplexer. 5: Will be able to demonstrate the conversion of Flip-Flop. 6: Will be able to demonstrate the decade asynchronous counter using 7490 IC. 7: Will be able to demonstrate the up-down synchronous counter using 74193 IC. 8: Will be able to demonstrate microprocessor programming. 9: Will understand the application of OPAMP and practical use. 10: Will be ready to design the circuit using OPAMP and flip-flop.
2	PPH-2806L	Physics Laboratory	1: Will be able to demonstrate the Inverse square law and end point energy of beta particles G M tube. 2: Will be able to demonstrate the Ultrasonic Interferometer. 3: Will be able to demonstrate the Dipole Moment of organic molecule Acetone. 4: Will be able to demonstrate the Velocity of Liquid using Surface wave. 5: Will be able to demonstrate the Dielectric constant of a non-polar liquid 6: Will be able to demonstrate the Hall Effect. 7: Will be able to Measure the Lattice dynamics

			8: Will be able to demonstrate Stefan's Constant of Radiation 9: Will understand the application of Ultrasonic Interferometer. 10: Will be ready to demonstrate application of dipole moment and dielectric constant.
3	PPH-3801	Electronics Comminication & Microprocessor Interfacing	1: Understand the importance of the modulation in the communication 2: Get information about different types of the modulation. 3: Learn theory of Amplitude modulation and different techniques through numerical, learn theory of FM wave through numericals. 4: Get idea of generation of side band and bandwidth of the FM signal. 5: Learn practical circuit used for generation of AM and FM wave. 6: Learn the principle of FM demodulation and different FM detectors used in the FM receiver. 7: Learn the pulse modulation technique including pulse amplitude, pulse width, pulse position and pulse code modulation. 8: Also learn the digital modulation including ASK, FSK, and PSK. 9: Study the microprocessor 8085 with its advanced instruction sets including stack, subroutines, call and return instruction 10: Study the interfacing of microprocessor kit with peripheral devices such as DAC and 8255 11: Solve numerical based on above concepts and topics.
3	PPH-3802	Nano Science & Photo Voltaic System	1: Learn some of the physical and chemical methods for the fabrication of Nanomaterial including various vacuum and non- vacuum deposition techniques 2: Understand some of the basic and advanced characterization techniques used to study the nanomaterial's as well as thin films. 3: Study mechanical, optical, structural, electrical and magnetic properties of nanomaterial. Further students will be studying Nano tubes of carbon including its types, preparation techniques, and some of the application. 4: At the end of the course students are able to describe the properties like physical, magnetic, conductivity etc. of nanomaterial's 5: Students are incapacity to explain the carbon nanotubes and quantum dots etc. and their applications.

			6: Understand generation and separation of electron-hole pairs in a photovoltaic device. 7: As well as collection of charges, generation of photo-voltage and flow of current through photovoltaic device. 8: And study some of the solar cell characterizations, working configurations, solar cell structures and practical working problems of solar cells.9: Understanding the solar simulator I-V measurements and quantum efficiency (QE) measurements. 10: Study of series and parallel connections of cell and mismatch in cell module. 11: Solve numerical based on above concepts and topics.
3	PPH-3803	Adv. Mathematics & Its Applications	1: Have a working knowledge of differentiability for complex functions and be familiar with the Cauchy-Riemann equations 2: To evaluate integrals along a path in the complex plane and understand the statement of Cauchy's Theorem, use Green functions. 3: Clarify the basic concepts of scattering and illustrate Rutherford's scattering experiment. Describe scattering amplitude and scattering cross section and also apply partial wave analysis to find the same. 4: Establish the expansion of a plane waves in terms of infinite number of spherical waves and obtain Bauer's formula. 5: Give example of scattering by an attractive square well potential. 6: Describe Breit-Wigner formula for resonant cross section. 7: Outline the Born approximation and explain the validity of Born approximation and also develop skill to compute the phase shift for s and p wave scattering. 8: Understand Python programming language, solve physics problems using Python 9: Understand Mathematica Software 10: Solve physics problems using Mathematica Software
3	PPH-3804	Introduction to Remote Sensing and Plasma Science	1: Fundamentals of plasma physics describing variety of plasma occurring naturally/artificially 2: Single particle picture under various electromagnetic field configuration, which will help to understand concept of confinement in tokamak device. 3: Collision phenomena in plasma describing collisional transport and resistivity.

			4: Fluid and kinetic description of plasma state, plasma waves and its experimental aspects 5: This overall prepare students foundation for further advanced plasma course like magnetically confined thermonuclear fusion reactor: tokamak 6: Get the end – to – end idea of remote sensing with historical perspective and current status of remote sensing 7: Understand and explain the properties of electromagnetic radiation of relevance to remote sensing 8: Understand the physical process leading to various signatures based on which targets are identified 9: Deal with sensors used for collection of remote sensing data 10: Understand the capabilities and limitation of various platforms to carry out remote sensing sensors 11: Solve problems based on above concepts.
3	PPH-3805L	Electronics Laboratory	1: Will be able to demonstrate the DC Characteristic of SCR. 2: Will be able to demonstrate the SCR as Half Wave Rectifier. 3: Will be able to demonstrate the Astable Multivibrator using IC 555. 4: Will be able to demonstrate the Monostable Multivibrator using IC 555. 5: Will be able to demonstrate the UJT as Relaxation Oscillator. 6: Will be able to demonstrate the RC Phase Shift Oscillator. 7: Will be able to demonstrate the D/A Converter. 8: Will be able to demonstrate Microprocessor Interfacing with PPI 8255 9: Will understand the application of SCR and practical use. 10: Will be ready to design the circuit using SCR and Multivibrator.
3	PPH-3806L	Physics Laboratory	1: Will be able to demonstrate the Frank – Hertz Experiment. 2: Will be able to d0 the Fourier Analysis. 3: Will be able to Study the Dielectrics. 4: Will be able to learn the properties and application of Lasers . 5: Will be able to demonstrate the Young's Modulus using Flexural Vibrations. 6: Will be able to demonstrate the Faraday Effect.

			7: Will be able to Measure the low Resistance using Lock-in Amplifier. 8: Will be able to Measure the Permeability of Air. 9: Will understand the application of Fourier Analysis. 10: Will be ready to demonstrate application of dielectric constant and laser experiment.
4	PPH-4801	Instrumentation and Microcontrollers	1: Study the drawbacks of two wire transmission lines at high frequency and the application of waveguides 2: Study the microwave junction and microwave sources including the klystron family. 3: Study and work with the microcontroller 8051, and will be designing the program including data transfer operation, arithmetic, logical, Boolean, and branching programs. 4: Design the Schmitt trigger, astable multivibrator and triangular wave generator using comparator circuits. 5: Know the importance of PLL IC, demonstrate the working of phase detector, comparator and VCO. 6: Design frequency multiplication\division using PLL. 7: Explain FM demodulation, FSK demodulator and AM detection. 8: Understand different concepts of Transducers, including those for measurement of temperature, strain, motion, position and light. 9: Choose proper transducer to make sensitive measurements of physical parameters like pressure, flow, displacement, velocity, temperature etc. 10: Locate different types of transducers and sensors used in real life applications. 11: Solve numerical based on above concepts and topics.
4	PPH-4802	Adv. Theoretical Physics & Cosmology	1: Describe Symmetry transformation and conservation law, explain translation in space and time; deduce conservation of linear momentum and conservation of energy. 2: Discuss rotation in space and obtain conservation of angular momentum, identify space inversion: parity conservation. 3: Obtain eigen value of the square of the angular momentum operator and z component of angular momentum operator. 4: Derive the angular momentum matrices, state Pauli's spin matrix and derive spin matrix of a spin (1/2) system

			5: Describe addition of angular momenta and obtain Clebsh-Gordan coefficient for a given system having two angular momenta 6: To explain the Dirac equation and its free-particle solutions, to explain the existence of antiparticles 7: Describe the classical and quantum mechanical treatment to understand many-body problem, describe the Kohn-Sham equation, pseudo-potential, exchange correlation functions for the material properties. 8: Distinguish different approaches for the density functional theory and compute its ground state energy and density, understand the modern theoretical methods based on ab initio simulations and they are so reliable that one can predict material properties. 9: To use an understanding of our galaxy to contrast and compare it with other galaxies as to type, contents, age, luminosity, motion, and size, to use cosmological models to analyse the size, age, structure, and motion of the universe overall. 10: Have a deep understanding of the physics and evolution of the smooth, homogeneous Universe starting from the Big Bang, to understand the dark matter issue and possible solutions and implications. 11: Solve numerical based on above concepts and topics.
4	PPH-4803	Adv. Nuclear Physics	1: Understand the importance of models in describing the properties of nuclei and nuclear collisions. 2: Understand how various types of accelerators work and understand differences between them. 3: Understand major applications of accelerators and the recent new concepts. 4: Able to account for central concepts within particle physics, such as symmetries, invariants, and conservation laws. 5: Understanding of nuclear reactions mechanisms, compound nuclei and direct reactions. 6: Able to understand radioactive ion beams and applications and understand of nucleosynthesis. 7: Understand how fusion process in the sun and stars take and understanding of controlled thermonuclear fusion.

			8: Able to understand the newer concepts in particle acceleration and Laser Wake-field acceleration. 9: Understanding the compact particle accelerators for application in medical sciences and health-care wellness. 10: Understand of Parity non-conservation in weak-interaction and relativistic kinematics. 11: Solve numerical based on above concepts and topics.
4	PPH-4804	Atmospheric sciences and Astronomy	1: Understand the relation between astronomy and astrophysics. 2: Apply principles of physics to astronomical objects. 3: Introduce students to the field of astrophysics with mathematically based principles. 4: Understanding the Interstellar medium and star formation. 5: Able to understand the telescopes and its different types and the resolution. 6: Understanding the image formation in a camera and focal plane instruments. 7: Able to understand the photometers, spectrometers and detectors. 8: Get the knowledge of radiative transfer within different layers of Atmosphere 9: Able to solve problems related to atmospheric science using their computational skills 10: Understand the vast field of Atmospheric science 11: Solve numerical based on above concepts and topics.
4	PPH-4805L	Physics Laboratory	1: Will be able to demonstrate the Zeeman Effect. 2: Will be able to demonstrate Hysteresis Loop Tracer. 3: Will be able to demonstrate the Electron Spin Resonance (ESR) 4: Will be able to demonstrate the Optical Fibre Experiment. 5: Will be able to measure the Permittivity of Air. 6: Will be able to demonstrate the Kerr Effect. 7: Will be able to measure Mutual Inductance using Lock-in Amplifier. 8: Will be able to demonstrate Phase Locked Loop (PLL). 9: Will be able to demonstrate Data Acquisition using Coupled Pendulum and Microcontroller 8081.

			10: Will be able to demonstrate Pulse Width Modulation and LVDT Transducer and Strain Gauge.
4	PPH-4806L	Project & Dissertation	1: Will be trained in identifying Projects by doing literature survey in forms of Research papers, journals and looking for ideas in internet. 2: He/She is also encouraged to come with original ideas which explain the concepts of Physics and electronics. 3: Will be trained in having "Hands on experience" with designing projects using various instruments, collecting data and in its analyses. 4: Will be able to document his project by writing synopsis and project report