Department of Physics

Nesamony Memorial Christian College, Marthandam

M. Sc. Physics

Course Outcome

Semester – I M. Sc. Physics					
Part	**Course Name**	**Course Code**	**Credit**	**Hours**	**Course Outcome**
Part - A	Core Course – I: **Mathematical Physics**	VPHC11	5	7	**CO1** Understand use of bra-ket vector notation and explain the meaning of complete orthonormal set of basis vectors, and transformations and be able to apply them **CO2** Able to understand analytic functions, do complex integration, by applying Cauchy Integral Formula. Able to compute many real integrals and infinite sums via complex integration. **CO3** Analyze characteristics of matrices and its different types, and the process of diagonalization. **CO4** Solve equations using Laplace transform and analyze the Fourier transformations of different function, grasp how these transformations can speed up analysis and correlate their importance in technology **CO5** Find the solutions for physical problems using linear differential equations and to solve boundary value problems using Green's function. Apply special functions in computation of solutions to real world problems
	Core Course - II: **Classical Mechanics and Relativity**	VPHC12	5	6	**CO1** Understand the fundamentals of classical mechanics. **CO2** Apply the principles of Lagran gian mechanics to solve the equations of motion of physical systems. **CO3** Apply the principles of Hamiltonian mechanics to solve the equations of motion of physical systems. **CO4** Analyze the small oscillations in systems and determine their normal modes of oscillations. **CO5** Understand and apply the principles of relativistic kinematics to the mechanical systems.
	Practical-I: **General Physics and Electronics Experiments** –	VPHL11	4	6	**CO1** Understand the strength of material using Young's modulus. **CO2** Acquire knowledge of thermal behavior of the materials. **CO3** Understand theoretical principles of magnetism through the experiments. **CO4** Acquire knowledge about arc spectrum and applications of laser **CO5** Improve the analytical and observation ability in Physics Experiments

					CO6 Conduct experiments on characteristics of FET Amplifier **CO7** Analyze various parameters related to operational amplifiers. **CO8** Understand the concepts involved in arithmetic and logical circuits using IC's **CO9** Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits **CO10** Analyze the applications of counters and registers
	Elective - I: **(Discipline Centric)** **Energy Physics**	VPHE11	3	5	**CO1** To identify various forms of renewable and non-renewable energy sources **CO2** Understand the principle of utilizing the oceanic energy and apply it for practical applications. **CO3** Discuss the working of a windmill and analyze the advantages of wind energy. **CO4** Distinguish aerobic digestion process from anaerobic digestion. **CO5** Understand the components of solar radiation, their measurement and apply them to utilize solar energy.
	Elective - II: (Generic) **Linear and Digital ICs and Applications**	VPHE12	3	6	**CO1** Learn about the basic concepts for the circuit configuration for the design of linear integrated circuits and develops skill to solve problems **CO2** Develop skills to design linear and non-linear applications circuits using OpAmp and design the active filters circuits. **CO3** Gain knowledge about PLL, and develop the skills to design the simple circuits using IC 555 timer and can solve problems related to it. **CO4** Learn about various techniques to develop A/D and D/A converters. **CO5** Acquire the knowledge about the CMOS logic, combinational and sequential circuit
Semester – II M. Sc. Physics					
Part - A	Core Course – III: **Statistical Mechanics**	VPHC21	5	6	**CO1**Examine and elaborate the effect of changes in thermodynamic quantities on the states of matter during phase transition **CO2** Analyze the macroscopic properties such as pressure, volume, temperature, specific heat, elastic moduli etc. using microscopic properties like intermolecular forces, chemical bonding, atomicity etc. Describe the peculiar behavior of the entropy by mixing two gases Justify the connection between statistics and thermodynamic quantities **CO3** Differentiate between canonical and grand canonical ensembles and to interpret the relation between thermo dynamical quantities and partition function **CO4** To recall and apply the different statistical concepts to analyze the behavior of ideal Fermi gas and ideal Bose gas and also to compare and distinguish between the three types of statistics. **CO5** To discuss and examine the thermo dynamical behavior of gases under fluctuation and also using I sing model

	Core Course - IV: **Quantum Mechanics** –I	VPHC22	5	6	**CO1** Demonstrates a clear understanding of the basic postulates of quantum mechanics which serve to formalize the rules of quantum Mechanics **CO2** Is able to apply and analyze the Schrodinger equation to solve one dimensional problems and three dimensional problems **CO3** Can discuss the various representations, space time symmetries and formulations of time evolution **CO4** Can formulate and analyze the approximation methods for various quantum mechanical problems **CO5** To apply non-commutative algebra for topics such as angular and spin angular momentum and hence explain spectral line splitting.
	Core Practical –II: Practical – II: **General Physics and Electronics Experiments – II**	VPHL21	4	6	**CO1** Understand the strength of material using Young's modulus **CO2** Acquire knowledge of thermal behavior of the materials **CO3** Understand theoretical principles of magnetism through the experiments. **CO4** Acquire knowledge about arc spectrum and applications of laser **CO5** Improve the analytical and observation ability in Physics Experiments **CO6** Conduct experiments on applications of UJT **CO7** Analyze various parameters related to operational amplifiers **CO8** Understand the concepts involved in arithmetic and logical circuits using IC's **CO9** Acquire knowledge about Combinational Logic Circuits and Sequential Logic Circuits **CO10** Analyze the applications of counters and registers
	Elective - III: **(Discipline Centric) Physics of Nano Science and Technology**	VPHE23	4	4	**CO1** Understand the basic of nano science and explore the different types of nano materials and should comprehend the surface effects of the nano materials. **CO2** Explore various physical, mechanical, optical, electrical and magnetic properties nano materials. **CO3** Understand the process and mechanism of synthesis and fabrication of nanomaterials. **CO4** Analyze the various characterization of Nano-products through diffraction, spectroscopic, microscopic and other techniques. **CO5** Apply the concepts of nano science and technology in the field of sensors, robotics, purification of air and water and in the energy devices.
	Elective - IV: **(Industry Entrepreneurship) a) Microprocessor 8085&Microcontroller 8051**	VPHE24	4	4	**CO1** Gain knowledge of architecture and working of 8085 microprocessor. **CO2** Get knowledge of architecture and working of 8051 Microcontroller. **CO3** Be able to write simple assembly language programs for 8085A microprocessor. **CO4** Able to write simple assembly language programs for 8051 Microcontroller. **CO5** Understand the different applications of microprocessor and microcontroller.

	SEC - I: (PCS) **Physics for Competitive Examinations 4**	VPHSE21	4	4	**CO1** Acquire the knowledge of the fundamental concept of physics **CO2** Understand the concepts of fundamental physics **CO3** Apply the concept of physics to solve various problems **CO4** Strengthen an appropriate problem-solving approach and assess a step to describe the quantitative analysis. **CO5** Evaluate the results of new analytical problems and develop a correct solutions or conclusions
Semester – III M. Sc. Physics					
Part - A	Core Course –V: **Quantum Mechanics-II**	WPHM31	5	5	**CO1** Familiarize the concept of scattering theory such as partial wave analysis and Born approximation **CO2** Give a firm grounding in relativistic quantum mechanics, with emphasis on Dirac equation and related concepts **CO3** Discuss the relativistic quantum mechanical equations namely, Klein-Gordon and Dirac equations and the phenomena accounted by them like electron spin and magnetic moment **CO4** Introduce the concept of covariance and the use of Feynman graphs for depicting different interactions **CO5** Demonstrate an understanding of field quantization and the explanation of the scattering matrix.
	Core Course -VI: **Condensed Matter Physics**	WPHM32	5	5	**CO1** Student will be able to list out the crystal systems, symmetries allowed in a system and also the diffraction techniques to find the crystal structure **CO2** Students will be able to visualize the idea of reciprocal spaces, Brillouin Zone and their extension to band theory of solids. **CO3** Student will be able to comprehend the heat conduction in solids **CO4** Student will be able to generalize the electronic nature of solids from band theories. **CO5** Student can compare and contrast the various types of magnetism and conceptualize the idea of superconductivity.
	Core Course -VII: **Numerical Methods and Programming**	WPHM33	5	5	**CO1** Recall the transcendental equations and analyze the different root finding methods. Understand the basic concept involved in root finding procedure such as Newton Raphson and Bisection methods ,their limitations. **CO2** Relate Simultaneous linear equations and their matrix representation Distinguish between various methods in solving simultaneous linear equations. **CO3** Understand, how interpolation will be used in various realms of physics and Apply to some simple problems Analyze the newton forward and backward interpolation **CO4** Recollect and apply methods in numerical differentiation and integration. Assess the trapezoidal and Simpson's method of numerical integration. **CO5** Understand the basics of C++-programming and conditional statements

	Core Practical- III: **(Industry Module) Advanced Physics Experiments-I and Microprocessor 8085 & Microcontroller 8051 Programming**	WPHL31	4	6	**CO1** Determination of some physical constants using specialized instruments **CO2** Spectral data analysis techniques and interpretation **CO3** Simulation of some physical experiments using specialized software **CO4** Hands on experience with microprocessor Programming **CO5** Hands on experience with Microcontroller Programming
	Elective -V: **Spectroscopy**	WPHE31	3	5	**CO1** Understand fundamentals of rotational spectroscopy, view molecules as elastic rotors and interpret Their behaviour. Able to quantify their nature and correlate them with their characteristic properties. **CO2** Understand the working principles of spectroscopic instruments and theoretical background of IR pectroscopy. Able to correlate mathematical process of Fourier transformations with instrumentation. Able to interpret vibrational spectrum of small molecules. **CO3** Interpret structures and composition of molecules and use their knowledge of Raman Spectroscopy as an important analytical tool **CO4** Use these resonance spectroscopic techniques for quantitative and qualitative estimation of a substances **CO5** Learn the electronic transitions caused by absorption of radiation in the UV/Vis region of the electromagnetic spectrum and be able to analyze a simple UV spectrum.
Part - B	SEC - II: **(Industry Oriented) Sewage and Waste Water Treatment and Reuse**	WPHSE31	2	4	**CO1** Gained knowledge in solid waste management **CO2** Equipped to take up related job by gaining industry exposure **CO3** Develop entrepreneurial skills **CO4** Will be able to analyze and manage the status of the solid wastes in the nearby areas **CO5** Adequately sensitized in managing solid wastes in and around his/her locality
	Internship / Industrial Activity/ Field visit/ Research Knowledge updation Activity / Literacy **Internship Report to be submitted to the Department**		2	External Valuation required	

Semester – IV M. Sc. Physics					
Part - A	Core Course VIII:- **Nuclear and Particle Physics**	WPHM41	5	6	**CO1** Gain knowledge about the concepts of helicity, parity, angular correlation and internal conversion. **CO2** Demonstrate knowledge of fundamental aspects of the structure of the nucleus,radioactive decay, nuclear reactions and the interaction of radiation and matter. **CO3** Use the different nuclear models to explain different nuclear phenomena and the concept of resonances through Briet- Weigner single level formula **CO4** Analyze data from nuclear scattering experiments to identify different properties of the nuclear force. **CO5** Summarize and identify allowed and forbidden nuclear reactions based on conservation laws of the elementary particles.
	Core Course -XII: **Advanced Physics Experiments - II and Numerical Methods in C++**	WPHL41	4	6	**Section A** **CO1** Students will be able to evaluate the efficiency and performance of solar cells by analyzing their spectral response to different wavelengths of light. **CO2** Students will understand the functional characteristics of ADCs, including linearity, accuracy, resolution, and dynamic range, through practical examination of the ADC 0804. **CO3** Students will be able to characterize the current-voltage relationship of a CdS photo resistor under constant irradiance conditions. **CO4** Students will be able to determine and analyze the temperature coefficient of resistance for a thermistor using the Carey Foster Bridge method. **CO5** Students will be able to measure and interpret the spacing between tracks on optical discs using diffraction patterns generated by a solid-state laser. **CO6** Students will gain practical experience in verifying and applying Norton's, Thevenin's, and Maximum Power Transfer theorems in electrical circuits. **CO7** Students will understand and evaluate the performance characteristics of load cells, including their response to varying loads. **CO8** Students will acquire the ability to design, implement, and test serial shift registers using flip-flops and integrated circuits. **CO9** Students will learn to design and construct encoder and decoder circuits, understanding their principles and applications in digital systems. **CO10** Students will be able to analyze the properties of a quartz crystal and construct a Pierce crystal oscillator, understanding its operation and applications. **CO11** Students will develop skills in using simulation software to model and analyze satellite orbits

					based on the universal law of gravitation. **Section B** **CO1** Students will be able to apply the Newton Raphson method manually to solve given equations and implement it in C++ for verification. **CO2** Students will demonstrate proficiency in applying the Bisection method manually and implementing it in C++ to find solutions, ensuring accuracy through verification. **CO3** Learners will understand the principle of least squares and successfully fit a straight line to given data using C++, applying it to physics experiments. **CO4** Students will grasp the principle of least squares for nonlinear fits and implement it in C++ to fit a polynomial to experimental data, specifically exploring physicsrelated datasets. **CO5** Students will derive the Lagrangian interpolation formula and apply it in C++ to interpolate data from physics experiments, gaining practical experience in numerical methods. **CO6** Students will comprehend the Gauss Elimination method for solving simultaneous equations and implement it in C++ to find unknown branch currents in a Wheatstone bridge, linking numerical methods to circuit analysis. **CO7** Learners will derive the exponential law of radioactive decay and employ the RK 4th order method in C++ to solve differential equations, comparing results to analytical solutions in a radioactive decay scenario. **CO8** Students will understand and derive the Trapezoidal and Simpson's rules for numerical integration and implement corresponding C++ programs, validating their accuracy through comparison with direct integration methods. **CO9** Students will be proficient in generating and scaling random numbers in C++ using library functions and applying the Monte Carlo method to evaluate integrals, integrating randomness into numerical methods. **CO10** Students will demonstrate competence in matrix multiplication, comprehend rotation matrix concepts, and implement a C++ program to rotate 2D objects about the origin, emphasizing practical applications in computer graphics or physics simulations. **CO11** Students will apply numerical differentiation to solve physical problems, derive Newton’s law of cooling equation, and validate it through a C++ program analyzing experimental data connecting mathematical modeling to real-world phenomena.
	Elective - VI:**(Generic) Electro Magnetic**	WPHE41	3	6	**CO1** Solve the differential equations using Laplace equation and to find solutions for boundary value problems

	Theory				**CO2** Use Biot-Savart's law and Ampere circuital law to find the magnetic induction & magnetic vector potential for various physical problems **CO3** Apply Maxwell's equations to describe how electromagnetic field behaves in different media **CO4** Apply the concept of propagation of EM waves through wave guides I optical fiber communications and also in radar installations, calculate the transmission and reflection coefficients of electromagnetic waves **CO5** Investigate the interaction of ionized gases with self-consistent electric and magnetic fields
Part - B	SEC - III: **(Industry Oriented) Solar Energy Utilization**	WPHSE41	2	4	**CO1** Gained knowledge in fundamental aspects of solar energy utilization **CO2** Equipped to take up related job by gaining industry exposure **CO3** Develop entrepreneurial skills **CO4** Skilled to approach the needy society with different types of solar cells **CO5** Gained industrialist mindset by utilizing renewable source of energy
	Core Project **Project with viva voce**	WPHP41	8	8	
Part - C	Extension Activity /Pollution Awareness/Literacy / Voluntary Services **Report to be submitted to the Department**		1	External Valuation required	