SACRED HEART COLLEGE (AUTONOMOUS)

Tirupattur – 635 601, Tamil Nadu, S.India

Resi : (04179) 220103
College : (04179) 220553
Fax : (04179) 226423

Ready for
Every Good Work

A Don Bosco Institution of Higher Education, Founded in 1951 * Affiliated to Thiruvalluvar University, Vellore * Autonomous since 1987

Accredited by NAAC (4th Cycle – under RAF) with CGPA of 3.31 / 4 at 'A+' Grade

Name of the Programme: M.Sc Physics

S No	Title Of The Paper	Course Code	Course Objectives	Course Outcomes	Relevance
1	Mathematical Physics - I	P717	• To understand the basic concepts of matrices and complex numbers • To impart the knowledge of the integral transforms such as Fourier transform and Laplace transform in detail. • To make the students to understand and solve problems on linear differential equations and series solutions of differential equations • To enable the students to understand the basic principles and importance of tensor analysis, • To learn the basic notations, theorem and probability distribution in physics.	• Revise and understand the concepts of matrices and to perform basic mathematical operations (arithmetic operations) with complex numbers in Exponential, circular functions and hyperbolic functions. • Distinguish between Fourier and Laplace transform, and make them to apply the knowledge of F.T, L.T and Finite Fourier transforms in finding the solutions of differential equations, initial value problems and boundary value problems. • Classify linear and partial differential equations and can solve problems of 1^{st} and 2^{nd} order linear differential equation, their solutions, also series solutions of linear differential equation. • Understand tensors and their concise mathematical framework for formulating and solving physics problems in areas such as elasticity, fluid mechanics, and general relativity. • Acquire the basic knowledge on probability concepts and theorems of probability	global developmental needs
2	Classical Mechanics And Statistical Mechanics	P718	• To introduce the classical formulation approaches like Lagrangian and Hamiltonian dynamics and to study their application in mechanical systems and solving of problems. • To disseminate the theory and methods of Hamilton Jacobi's Formulation and small oscillation theory that can be effectively applied to solve mechanical problems.	• Have in-depth knowledge about Lagrangian and Hamiltonian dynamics • Apply and solve problems in mechanical systems using Hamilton-Jacobi and Small Oscillations. • Demonstrate and analyse principal coordinates and the principal moments of inertia for arbitrary rigid body application. • Learn different statistical ensembles, their distribution functions, ranges of applicability	global developmental needs

			• To educate the students to identify, formulate and solve problems in rigid body dynamics. • To review the fundamental concepts of thermodynamics and to create an understanding of the principles of classical and quantum Statistical Mechanics and their applications. • To develop quantum simulations that bring into the statistical description using Bose-Einstein and Fermi-Dirac Statistics.	and the corresponding thermodynamic potentials. • Acquire knowledge to calculate basic thermo dynamical quantities: energy, specific heat, entropy, Helmoltz free energy, etc in classical and quantum statistical models.	
3	Quantum Mechanics – I	P719	• To provide an understanding of fundamental principles of quantum mechanics and the one-dimensional applications of Schrodinger's equation. • To introduce the students to the basic ideas of operator formalism and also to apply Schrodinger's equation for three-dimensional quantum problems. • To gain knowledge on matrix formalism and to analysis the symmetries and conservation laws in unitary transformations. • To impart the knowledge on time independent approximations in quantum mechanics. • To make the students to understand the concepts of angular momenta and their commutational rules and also matrix representations.	• Gain knowledge of development of quantum ideas and learn the wave nature of matter, uncertainty principle, Schrodinger's wave equation and its one-dimensional applications. • Understand the operator formalism and its application for one dimensional and three-dimensional quantum problems. • Gain knowledge on matrix formalism and unitary transformations. • Understand the importance of few time dependent approximations and their applications. • Acquire the knowledge on angular momentum, identical particles and Pauli's spin matrices.	global developmental needs

4	Elective: Energy And Environmental Physics	P720B	• To introduce the students to energy and various types of energy conversion techniques, energy collection and laws of thermodynamics. • To impart the knowledge on nonrenewable energy to the students. • To ensure that the students gain knowledge regarding renewable energy. • To introduce the students regarding Bioenergy Resources and Fuel Cells • To enlighten the students regarding the energy crisis and environmental pollution and to inculcate various means to control pollution to safeguard environment.	• Gain knowledge about energy, energy harvesting and saving. • Acquire ideas about nonrenewable energy. • Understand and gain knowledge about renewable energy. • Gain knowledge about Biomass and various types of Fuel Cells. • Be aware of environmental pollution and will know how to control them.	global developmental needs
5	Mathematical Physics - Ii	P820	• To provide an insight into complex analysis and enable the students to solve problems. • To make the students to learn Green's function and its applications in different fields of physics. • To impart the knowledge to understand series solutions and special functions and enable them to apply it to solve Physics problems. • To make the students learn to solve various types of problems related to numerical techniques. • To enable the students to understand the basics of group theory, that will make them to analyze symmetries and their implications in the field of Physics.	• Acquire the knowledge of complex derivatives function and operate analytic functions, and solve problems in complex integrations. • Understand homogeneous and non-homogeneous equation to solve Green's functions along with boundary value problems. • Gain the knowledge of series solutions and special functions and enable them to apply and solve problems in classical, statistical, quantum mechanics and electromagnetism. • Distinguish numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, and solution of first order differential equations and enable them to solve problems. • Recognize the basic ideas of groups, representations of groups, character table formation and application of group theory.	global developmental needs

6	Quantum Mechanics–Ii	P822	• To understand the concept of time dependent perturbation theory. • To provide knowledge on scattering theory in quantum mechanics. • To learn basic ideas of relativistic quantum mechanics of charged particles • To impart knowledge on Dirac equation and the transformations for Dirac equation. • To introduce the students to quantum field theory through the learning of relativistic Lagrangian and Hamiltonian formalisms.	• Learn and understand the fundamental principle of time dependent perturbation theory and its application to physical situations. • Gain knowledge on scattering phenomena occurring in quantum mechanics. • Understand the fundamental principles of relativistic quantum mechanics and solution of KG equation for charged particles in electromagnetic field. • Acquire knowledge of Dirac equation and matrices and their role in Lawrence transformation of Dirac equation. • Understand the concept of quantum field theory by learning relativistic Lagrangian and Hamiltonian formulations.	global developmental needs
7	Solid State Physics	P917	• To provide an understanding of the basics of crystal physics and X-ray diffractions • To introduce the concept of Lattice dynamics • To familiarise the various theoretical models to study the properties of matter from a microscopic point of view. • To provide an understanding of magnetic materials and theirproperties. • To familiarise with superconducting materials.	• Understand crystal structure and diffraction of X-rays in materials • Acquire knowledge; understand the behaviour of electrons in solids based on classical and quantum theories and various theories of specific heat capacities of solids. • Understand theoretical backgrounds of metals and semiconductors • Describe the theories of magnetic materials and how the susceptibility varies with temperature. • Explore superconductivity and its applications.	global developmental needs

8	Atomic And Molecular Spectroscopy	P918	• To provide a knowledge of interaction of electromagnetic radiation with atoms and molecules and systematically introduce to spectra and basic theoretical concepts in spectroscopic methods. • To expose to the fundamental principles of various spectroscopic techniques for structural applications. • To understand the theory and principles of electronic and vibrational and its techniques. • To Study microwave spectroscopy and its advantages/applications. • To understand the physics behind NMR and ESR spectroscopy, Mossbauer spectroscopic techniques.	• Apply their knowledge and understand different branches of spectroscopy and carry out experimental and theoretical studies on atoms and molecules with focus on the structure and dynamics. • Apply the knowledge of spectroscopy in interdisciplinary subjects like chemistry, mathematics and biological systems. • Handle relevant experimental equipment and evaluate experimental results obtained • Excel in research field related to materials science and various spectroscopic analyses. • Apply NMR and ESR spectroscopy, Mossbauer spectroscopic techniques to examine new materials for novel drugs in the field of medicine	global developmental needs
9	Elective: Optical Physics	P920B	• To introduce the concept of waves, wave packets, polarization and Brewster angle • To make the students to understand the concept of coherence and interference • To acquire knowledge of working principle of different type of lasers • To get in depth knowledge on propagation of light in the fiber and wave guides • To understand the electro-optic and magneto-optic effects and their application	• Understand the concept of waves, wave packets, polarization and Brewster angle • Distinguish spatial and temporal coherent and they can understand the spectral resolution • Realize the working principle of different type of lasers • Explain construction and applications of optical fibers • Understand and appreciate the various optical devices and their applications in different fields.	global developmental needs

10	Elective: Computational Quantum Mechanics	P920C	• To introduce modern methods of molecular modeling and culminating in electronic structure modeling. • To understand the Basic methods of molecular modeling. • To enable the students to acquire knowledge Roothaan-Hall Hartree-Fock method and its application • To introduce Ab initio formalism of quantum computation. • To explore the Knowledge on Density Functional theory and its application.	• Understand quantum mechanical approximation models necessary for the description of molecules and atoms. • Understand the relationship between the energy levels obtained as solutions to the time-independent Schrödinger equation and measurements made using spectroscopic methods. • Plan and apply computer-based calculations to determine the geometry, energies and electronic properties of molecules. • Describe theoretical methods and plan and conduct computer-based calculations of chemical properties in molecules • Present and discuss density functional theory for computing the energy of molecules through a one-electron Schrödinger equation that includes electron correlation.	global developmental needs
11	Self-Study Paper: Research And Publication Ethics		• To create awareness about publication ethics and publications misconduct • To analyse the academic integrity and to create awareness about predatory publications • To understand the publication ethics, authorship and contributorship-Identification of publication misconduct etc. • To identify good journals for publishing one's research article • To check plagiarism using plagiarism software like Turnitin, Urkund and other open source software tools.	• Infer the knowledge about the ethics with respect to science and research, Intellectual honesty and research integrity scientific misconducts etc. • Acquire awareness about publication ethics and publications misconduct • Acquire knowledge about predatory and fraudulent journals • Identify good journals for publishing their research articles • Check plagiarism using plagiarism software like Turnitin, Urkund and other open source software tools.	global developmental needs

12	Elective: Modern Optics	P1017A	• Provide a thorough foundation in the optical physics of both second order and third order nonlinear optical phenomena. • Understand nonlinear phenomena from the fundamental perspective of quantum mechanics. • To understand third order nonlinear optical phenomena of the materials. • To expose the students to the optical fiber communication systems and to explain the importance and advantages of optical fiber communications, basic problems and possible mitigations. • To understand the fundamentals of optical properties of materials for various applications.	• Predict the frequencies generated by a nonlinear optical process • Understand stimulated Raman and Brillouin scattering • Estimate the upper bound of optical power in silica fiber due to nonlinearity • Recall the basic structure of an optical fiber and the pulse propagation in optical fibers and also can explain the various types of dispersions in optical fibers and their mitigations by deploying various types of optical fibers • Obtain knowledge about optoelectronic materials, their properties and applications.	Global developmental needs
13	Analytical Instrumentation And Characterization Techniques		• To introduce to the students the basics of X-Ray diffraction in solids and train them collect and interpret the X-ray data. • To recall Beer's law and the basics of UV-Visible spectroscopy and give them the hands-on-training on collection and interpretation of data. • To provide hands-on-training on collection and interpretation of FTIR data. • To provide hands-on-training on collection and interpretation of dielectric data • To provide hands-on training on photoacoustic spectrometer.	• Collect and interpret the X-ray data and draw conclusions. • Acquire the skills needed for the interpretation of data collected from UV-Vis spectrometer. • Interpret FTIR spectra. • Draw plots and make conclusions from them. • Get the knowledge about photoacoustic spectrometer	Global developmental needs