ST. JOSEPH'S COLLEGE, DEVAGIRI, CALICUT
(AUTONOMOUS)

POST GRADUATE DEGREE PROGRAMME

ST. JOSEPH'S CHOICE BASED CREDIT SEMESTER SYSTEM
(SJCBCSSUG)

MASTER OF SCIENCE
IN
PHYSICS

Course Outcome
(2019Admn Onwards)

COURSE OUTCOMES

CORE COURSES

SEMESTER I
FPHY1C01: CLASSICAL MECHANICS

COs	COURSE OUTCOMES
CO1	Explain the fundamental concepts in Lagrangian and Hamiltonian formulation in mechanics.
CO2	Apply the concepts of Lagrangian, Hamiltonian, Action, Poisson brackets, canonical tranformations and their subsequent development to Heisenberg's matrix mechanics and Schrodinger's wave mechanics, to carry out numerical problems
CO3	Develop the analytical and mathematical skills for describing the dynamics of rigid bodies. It could be applied to practical situations. This can be applied spectroscopic analysis of samples
CO4	Explain the theory of small oscillations. Small oscillations are part and parcel of all bound physical systems
CO5	Elucidate the concepts in nonlinear dynamics and chaos. These techniques can be directly applied in nonlinear physics and also to verify various experimental results

SEMESTER I
FPHY1C02 : MATHEMATICAL PHYSICS – I

COs	COURSE OUTCOMES
CO1	Describe coordinate systems appropriate for different physical problems. Applies it to solve Laplace's equation in different coordinate systems
CO2	Peform transformation operations and get the corresponding transformation matrices. Learns procedures for matrix diagonalisation
CO3	Distinguish the class of objects called tensors, their classifications and use. Understand differential equations of special nature and the ways to solve them
CO4	Identify differential equations of special nature and the ways to solve them
CO5	Illustrate special functions as solutions to problems in atomic, molecular nuclear, and solid state physics etc. and will put them in use
CO6	Distinguish Fourier series and integral transforms of different types and their properties. This will enable him/her to analyse or solve different mathematical problems in physical sciences

SEMESTER I
FPHY1C03: ELECTRODYNAMICS AND PLASMA PHYSICS

COs	COURSE OUTCOMES
CO1	Explain the significance of displacement current and Maxwell's equations and general electromagnetic wave equations, their solutions in terms of potentials and fields. Another basic concept of physics called gauge transformation will be understood. Multipole expansion of the potentials, fields and multipole moments of different orders will be learned
CO2	Describe the propagation of electromagnetic waves through free space and the consequences of reflection from different types of boundaries. These have important consequences in wave propagation
CO3	Discusses propagation of electromagnetic waves through confined media like wave guides and cavity resonators
CO4	Enables to appreciate the magnificent results of the blending of relativity and electrodynamics and motivates to take up a course on quantum field theory, the study of fields, interactions and symmetries
CO5	Understand the criteria for a medium to be called plasma and the various properties of it

SEMESTER I
FPHY1C04: ELECTRONICS

COs	COURSE OUTCOMES
CO1	Analyse characteristics of JFET and MOSFET and their specific applications
CO2	Distinguish the basic characteristics of light emitting and light sensing devices and illustrate the basic concepts behind integrating electronic and photonic devices suitably for microwave communication.
CO3	Classify characteristics of op-amps and their implementation in various elementary level applications
CO4	Identify the basics of logic gates, flip flops and registers and the designing of counters, satisfying specific conditions. Understands RAM and D/A converter and basic features of specific microprocessors

SEMESTER II
FPHY2C05: QUANTUM MECHANICS-I

COs	COURSE OUTCOMES
CO1	Appreciate the importance and implication of vector spaces. Will be able to use Dirac ket and bra notations. Use operators and will be able to solve eigen value problems. Understand generalized uncertainty principle in quantum mechanics and the need for quantum mechanical formalism and its basic principles
CO2	Explain time evolution of quantum mechanical systems and learn different time evolution approaches -Schrodinger picture and Heisenberg picture. Apply different approaches in quantum dynamics to various fundamental problems
CO3	Develop a better understanding of the mathematical foundations of spin and angular momentum. Make use of spherical harmonics to compute Clebsch - Gordon coefficients
CO4	Apply Schrodinger's equation to central potentials problems, to solve various quantum mechanical problems
CO5	Understand invariance principles based on symmetry of the system and establish the associated conservation laws. These quantum mechanical concepts will be applied to analyse the ground state of Helium atom. Here it will be understood that all symmetry elements possess the mathematical property of groups

SEMESTER II
FPHY2C06: MATHEMATICAL PHYSICS-II

COs	COURSE OUTCOMES
CO1	In general, physical phenomena are expressed in equations involving complex quantities. Some times we get complex solutions to equations. Solving such problems requires special procedures. On completing this module he/she will be gain the skill for solving and interpreting such problems
CO2	Acquire a preliminary training in group theory. All symmetry elements possess the mathematical property of groups. Concepts of group theory will help to solve problems in quantum mechanics. It is quantum mechanics that gives more stress on symmetry than classical mechanics
CO3	Apply the techniques of calculus of variation to diverse problems in physics
CO4	Apply the Greens function technique to solve problems showing causality relationships

SEMESTER II
FPHY2C07: STATISTICAL MECHANICS

COs	COURSE OUTCOMES
CO1	Understand macroscopic and the microscopic states, thermodynamic potentials, basic concepts of entropy, Liouville‟s theorem and its consequences. Also the students will have an understanding of the connection between statistics and thermodynamics
CO2	Have a detailed understanding different canonical ensembles
CO3	Develop an understanding of the statistical behavior of Bose-Einstein and Fermi- Dirac systems

SEMESTER II
FPHY2C08: COMPUTATIONAL PHYSICS

COs	COURSE OUTCOMES
CO1	Write computer programs using core python.
CO2	Use advanced mathematical modules like Numpy and Pylab in python program for solving mathematical and physical problems and also to present the result visually using graphs and charts.
CO3	Solve numerically mathematical problems like interpolation, curve fitting, integration etc. and to write python programs for these..
CO4	Solve numerically mathematical problems like differential equations, Fourier transforms etc. and also to write python program for these
CO5	Analyse by simulating simple physical problems in physics like one-dimensional and two-dimensional motion, harmonic oscillator, radio active disintegration, chaos, solution of Schrodinger equation etc., using python programs by applying the knowledge acquired for the course

SEMESTER I & II
FPHY1L01 & FPHY2L03: GENERAL PHYSICS

COs	COURSE OUTCOMES
CO1	Understand and analyze mechanical properties of materials
CO2	Understand and analyze the electrical and magnetic properties of materials
CO3	Understand and analyze the thermal and optical properties of materials

SEMESTER I & II

FPHY1L02 & FPHY2L04: ELECTRONICS

COs	COURSE OUTCOMES
CO1	Understand the characteristics of various transistors
CO2	Understand the amplification properties of electronic components
CO3	Understand and apply the properties of OPAMPs
CO4	Understand and analyze the applications of digital ICs

SEMESTER III

FPHY3C09: QUANTUM MECHANICS –II

COs	COURSE OUTCOMES
CO1	Understand time independent perturbation theory and to apply it to harmonic and anharmonic oscillators, and learn the fine structure and hyperfine splitting of Hydrogen atom in the presence of external magnetic and electric fields
CO2	Apply methods like Ritz variational technique and WKB approximation to quantum mechanical systems
CO3	Interpret time dependent perturbation theory and apply it to describe radiative transitions in atoms. Understand Fermi's Golden rule and learn Born approximation
CO4	Explain the theory of scattering and apply the method of partial waves to scattering by central potential and square well potential
CO5	Identify the principles of relativistic quantum mechanics and apply to Dirac particles, Klein-Gordon equation. Also understand the concept of spinors and the non-relativistic limit and Hole theory

SEMESTER III

FPHY3C10 : NUCLEAR AND PARTICLE PHYSICS

COs	COURSE OUTCOMES
CO1	Interpret the properties of nucleus, binding energy, angular momentum, two nucleon scattering, spin dependence, tensor force, partial wave concept and the theory of deuteron structure
CO2	Elucidate the theory of various types of nuclear decay, selection rules of transition, concept of parity and multipole moments
CO3	Compare various nuclear models and nuclear processes like fission and fusion. Will be able to apply it to various nuclear systems in the chart of nuclides
CO4	Demonstrate the working of one or two nuclear radiation detectors of different types and the signal processing and analysing units.
CO5	Compare basic interactions and classify the elementary particles. Interactions are linked with the concept of symmetry and conservation laws. Understand Sakata model, Gellmann- Okubo mass formula, Quark mode and their significance

SEMESTER III

FPHY3C11: SOLID STATE PHYSICS

COs	COURSE OUTCOMES
CO1	Analyse the structure of materials based on X-ray diffraction and interpret it on the basis of the theory understood
CO2	Distinguish different excitations in crystals. Properties of quasi particles could be explained. Arrive at proper explanation of for specific heat
CO3	Explain free electron model and interpret the properties of metals. Gain a deeper understanding of the energy bands based on the properties of carriers
CO4	Interpret properly the thermal, electrical and magnetic properties of materials. Will enable the student to understand the current research going on in the related areas.
CO5	Illustrate using phase diagrams, phase transitions in materials leading to superconductivity and different types of superconductors

SEMESTER III

FPHY3E01: ELECTIVE I: PLASMA PHYSICS

COs	COURSE OUTCOMES
CO1	Explore the motion of plasma particles in electric and magnetic fields. Enable to identify adiabatic invariants
CO2	Apply the principles of electrodynamics to understand the production and propagation of waves in plasma
CO3	Understands the factors affecting instability of plasma
CO4	Analyse Landau damping and its effects in plasma.
CO5	Understand free electron laser action in plasma. Analyses the hurdles in plasma confinement

SEMESTER III

FPHY3E02: ELECTIVE I: ADVANCED QUANTUM MECHANICS

COs	COURSE OUTCOMES
CO1	Explain the subtle nature of quantum behaviour of particles and fields. Properties of waves and wave functions of particles are demonstrated through Bohm-Aharanov effect
CO2	Show that experiments supported Copenhagen interpretation
CO3	See that experiments were in support of nonlocality concepts
CO4	Observe that Schrodinger cat gedenkan experiment also could not support Einstein's arguments
CO5	Accept that observation influences or affects quantum mechanical systems. Entanglement and collapse of wavefunctions could also be understood from here

SEMESTER III

FPHY3E03: ELECTIVE I: RADIATION PHYSICS

COs	COURSE OUTCOMES
CO1	Verify through experiments that radiations are primarily divided into ionising and nonionising. Also understand different sources under each category. Production methods of each will also be identified
CO2	Analyse the interaction mechanism of each category, giving emphasize to scattering and absorption
CO3	Exposure leads to beneficial or harmful effects. Understands details of both
CO4	Analyse both stochastic and deterministic effects depending upon radiation dose received.
CO5	Implement proper shielding in laboratory where sources are stored and in transportation
CO6	After M.Sc Physics, if PG Diploma courses of BARC or other recognised institutions are carried out, there are plenty of opportunities for radiation physicists in an outside the country

SEMESTER III

FPHY3E04: ELECTIVE I: DIGITAL SIGNAL PROCESSING

COs	COURSE OUTCOMES
CO1	Use concepts of complex analysis, Fourier transform, z-transform to analyse the operations on signals and acquire knowledge about System
CO2	Have proper understanding of frequency domain analysis of discrete time signals
CO3	Ability to identify, formulate, analyze and solve problems involving digital signals
CO4	Ability to use the techniques, skills and modern technical tools necessary for technical or engineering practice
CO5	Design, implementation, analysis and comparison of digital filters for processing of discrete time signals

SEMESTER III

FPHY3E05: ELECTIVE I: EXPERIMENTAL TECHNIQUES

COs	COURSE OUTCOMES
CO1	Explain vacuum, Gauges to measure vacuum, types of pumps and their utility, cryogenics etc
CO2	Explain and demonstrate different thin film fabrication techniques, thickness measurement and application of thin films
CO3	Explain different types of particle accelerators, their working and specific applications
CO4	Explain methods of materials analysis by different nuclear techniques
CO5	Be trained on defining X-ray techniques to characterise materials

SEMESTER III

FPHY3E06: ELECTIVE I: ELEMENTARY ASTROPHYSICS

COs	COURSE OUTCOMES
CO1	Plan the observation, given co-ordinates of a celestial source
CO2	Use the results of photometric and spectroscopic observation to study the properties of stars
CO3	Apply the principles of physics to understand stellar evolution
CO4	Understand various techniques involved in ground based observations.
CO5	Describe the techniques involved in the observation of celestial objects using space satellites

SEMESTER IV

FPHY4B12: ATOMIC AND MOLECULAR SPECTROSCOPY

COs	COURSE OUTCOMES
CO1	Understand the behavior of atoms and molecules and their interactions with electromagnetic waves
CO2	Apply the behaviour of nonrigid rotor and understand the microwave spectroscopy
CO3	Distinguish between Raman and IR spectroscopy and elucidate on the features of Raman spectrum
CO4	Explain electronic spectroscopy and applications
CO5	Identify the structure of the sample from spin resonance and Mossbauer spectra

SEMESTER IV

FPHY4E07: ELECTIVE II: ADVANCED NUCLEAR PHYSICS

COs	COURSE OUTCOMES
CO1	Explain various observed phenomena in nuclei with better accuracy
CO2	Apply the principles of rigid body dynamics and taking into account different core+nucleon coupling schemes, diverse phenomena at high angular momentum can be explained
CO3	Apply the principles of partial wave to analyse the results. Become conversant in the use compond nuclear formation theories
CO4	Understand nuclear binding energy and proceed through the statistical model calculations to estimate fission cross sections
CO5	Understand reactor physics, which is a special topic, more related to industry. Fick's law of diffusion for neutron flow and other considerations enables to estimate the critical mass and criticality condition in breeder reactors

SEMESTER IV

FPHY4E08: ELECTIVE II: ADVANCED ASTROPHYSICS

COs	COURSE OUTCOMES
CO1	Connect the observation of radiation in a particular wavelength from a celestial source to its possible nature and state
CO2	Understand the physics involved in the formation of variable stars
CO3	Compare various models involved in the formation and evolution of galaxies.
CO4	Explain how to develop cosmological models

SEMESTER IV

FPHY4E09: ELECTIVE II: ASTROPHYSICS AND ASTRONOMICAL DATA ANALYSIS

COs	COURSE OUTCOMES
CO1	Evaluate the basic parameters of a stellar object from the measured
CO2	Describe the stellar evolution stages and sequences of a single star and a binary star
CO3	Illustrate how surface photometry of galaxies change with their morphology
CO4	Interpret an X-ray image

SEMESTER IV

FPHY4E10: ELECTIVE II: ADVANCED STATISTICAL MECHANICS

COs	COURSE OUTCOMES
CO1	Illustrate how to find the total energy and specific heat as per Debye model in crystal lattice
CO2	Compare short distance and long distance interactions in nonideal systems
CO3	Explain Landau's theory of phase transitions
CO4	Interpret the results of spectral analysis of fluctuations

SEMESTER IV

FPHY4E11: ELECTIVE II: MATERIALS SCIENCE

COs	COURSE OUTCOMES
CO1	Aquire a basic understanding of the concept of formation of lattice defects in solids
CO2	Analyse the phase diagrams of single component, binary and ternary systems and diffusion in solids
CO3	Identify the cause of plastic deformation in crystals
CO4	Distinguish polymers and ceramics in terms of , their classifications, structure and properties
CO5	Apply the ideas of synthetic approaches of nanomaterials and their characterization methods
CO6	Understand the structure of buckminster fullerene, carbon nanotube, its classification and its applications

SEMESTER IV

FPHY4E12: ELECTIVE II: ELECTRONIC INSTRUMENTATION

COs	COURSE OUTCOMES
CO1	Students are able to design and convert a galvanometer into a voltmeter or an ammeter or design a general purpose multi-meter
CO2	Students are able to design different signal generators and quantify various signals using oscilloscopes
CO3	Students are able to the explain the changes on a sensor while varying different physical parameters and quantifying them to design and make various transducers
CO4	Students are able to explain the basic principles and working of various computer controlled testing systems for checking audio amplifiers and radio receivers and microprocessor based measurements
CO5	Students are able to explain the basic principle and working of SCR controlled current rectifiers, dc motors, armature current limiters

SEMESTER IV

FPHY4E13: ELECTIVE II: LASER SYSTEMS, OPTICAL FIBRES AND APPLICATIONS

COs	COURSE OUTCOMES
CO1	Understand the basic laser theory and the important laser systems.
CO2	Analyse the fundamentals of non linear optics and its applications
CO3	Identify the applications of lasers in various disciplines
CO4	Learn the importance of materials in nanoscale region and the quantum effect of nanomaterials
CO5	Identify applications of lasers in various disciplines
CO6	Understand the basics of Optical Fibers and its applications

SEMESTER IV

FPHY4E14: ELECTIVE II: COMMUNICATION ELECTRONICS

COs	COURSE OUTCOMES
CO1	Compare signal to noise ratios of Amplitude, Frequency and Angle modulation techniques based on circuit elements and signal to noise ratio
CO2	Compare amplitude and time modulations techniques in pulse modulated systems, able to quantify the errors in digital communication and suggest methods to correct it.
CO3	Differentiate between the circuit elements of AM and FM transmitters and receivers, explain the working of microwave systems
CO4	Classify signals based on time and frequency, differentiate the working of D/A and A/D convertors
CO5	Classify signals based on time and frequency, differentiate the working of D/ A and A/D convertors, explain different techniques for terrestrial and extraterrestrial signal communications

SEMESTER IV

FPHY4E15: ELECTIVE III: QUANTUM FIELD THEORY

COs	COURSE OUTCOMES
CO1	Understand the key concept of the use of harmonic oscillators as oscillatory quanta is introduced. Can carry out the canonical quantisation of electromagnetic and Schrodinger field.
CO2	Substantiate that for studying the behaviour of identtical many particle system, like atoms, molecules, nuclei, quantisation is a must. Quasi particles are also introduced.
CO3	Understand electron-photon interaction at a more fundamental level
CO4	All types of interactions can be analysed as current-current interactions. Nuclear decays can also be explained using this assumption
CO5	Tools like Feynman propagator and Greens functions can be made use of here

SEMESTER IV

FPHY4E16: ELECTIVE III: CHAOS AND NONLINEAR PHYSICS

COs	COURSE OUTCOMES
CO1	Illustrate different elliptic functions. To derive and qualitatively assess solutions of nonlinear differential equations
CO2	Understand how canonical invariants helps to distinguish Integrable systems
CO3	Analyse surface sections for two degrees of freedom. Ideas of symplectic mapping could be discussed. Apply these to practical nonlinear problems especially in fluid mechanics
CO4	Discuss turbulence and bifurcation theory and the concept of strange attractors to make the qualitative assessment of the dynamics of a given dissipative system by applying a geometrical way
CO5	Apply necessary mathematical tools to find the solutions of nonlinear partial differential equations

SEMESTER IV

FPHY4E17: ELECTIVE III: ADVANCED CONDENSED MATTER PHYSICS

COs	COURSE OUTCOMES
CO1	Understand the concept of first principle approximation and the requirement of DFT and HF approximations in molecular modeling
CO2	Analyse the phase diagrams in alloy formations and formulations of ternary and quaternary compositions of compounds
CO3	Understand different types of defects in crystals
CO4	Analyse the importance of materials in nanoscale region and the quantum effect of nanomaterials
CO5	Understand the importance of 2-dimentional materials and their applications in recent technology and development and growth of thin films by different techniques

SEMESTER IV

FPHY4E18: ELECTIVE III: MODERN OPTICS

COs	COURSE OUTCOMES
CO1	Understand that optics is electrodynamics at high frequency and enable the him/her to develop concrete concepts regarding the fundamentals of light propagation and polarization matrices
CO2	Analyse the phenomenon of optical coherence and its applications
CO3	Understand the physical principles of coherence in interference and its applications

CO4	Explain diffraction and establish its mathematical perspective in terms of Fourier .transforms
CO5	Understand the central concepts of the optics of solids

SEMESTER IV
FPHY4E19: ELECTIVE III: PHYSICS OF SEMICONDUCTORS

COs	COURSE OUTCOMES
CO1	Analyse the variation of band structure with temperature, doping concentrations etc and familiarize the experimental techniques
CO2	Understand the non linear nature of electrical conductivity depending on doping concentration in different regions
CO3	Familiarize the concept of changing electrical parameters of semiconductors and the phenomena such as Hall effect and thermoelectric effect
CO4	Analyse the role of impurity profile on the device characteristic as applied to tunnel diode
CO5	Describe the various trap and recombination mechanisms in semiconductors, phenomenon of electroluminescence. Understand the working of LED/ Laser diodes etc as application of trap centre

SEMESTER IV
FPHY4E20: ELECTIVE III: MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS

COs	COURSE OUTCOMES
CO1	To be equipped with essential knowledge on design and programming of simple microprocessor based systems
CO2	Develop basic skills in design of simple AVR microcontroller based embedded systems

SEMESTER III & IV
FPHY3L05 & FPHY4L06: MODERN PHYSICS

COs	COURSE OUTCOMES
CO1	Understand the nuclear physics experiments
CO2	Understand different experimental techniques
CO3	Understand the advanced electronics experiments
CO4	Understand the basics of lasers and fiber experiements
CO5	Understand the basics of spectroscopy

SEMESTER III & IV

FPHY4L07: COMPUTATIONAL PHYSICS PRACTICAL

COs	COURSE OUTCOMES
CO1	Development of numerical method for problem solving
CO2	Understanding pyhton language
CO3	Skill in writing program
CO4	Familarization with computer
CO5	Applications of python in physics problems