Semester I
Course Name: Classical Mechanics
Course Code: PP2011

No. of hours per week	No. of credits	Total No. of hours	Marks
6	4	90	100

Objectives

1. To have in depth knowledge in classical mechanics.
2. To enable students to develop skills in formulating and solving physics problems.
3. To study the kinematics of the rigid body through Euler equation.
4. To get knowledge in central force field and relativity.

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	understand the basic mechanical concepts related to single and system of particles.	PSO - 1	U
CO - 2	apply various mechanical principles to find solution for physical problems.	PSO - 4	Ap
CO - 3	solve the equations of motion using Lagrangian, Hamilton and Hamilton-Jacobi equations.	PSO - 6	C
CO - 4	explain the origin of coriolis and centrifugal terms in the equation of motion in a rotating frame.	PSO - 1	R
CO - 5	understand and develop a scientific knowledge in central force problems and relativity	PSO - 7	U

Teaching Plan

Total contact hours: 90 (Including lectures, assignments and Tests)

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	Lagrangian Formulation					
	1	Lagrangian formulation: System of particles - Constraints and degrees of freedom-	4	To understand the basic concepts of system of particles and	Illustration, Theoretical formulation, Lecture discussion	Evaluation through:

		Generalized coordinates, Force and Energy		generalized coordinates		multiple choice questions
	2	Conservation laws - Conservations of linear and angular momenta - Symmetric properties – Homogeneity and isotropy	4	To be able to understand the concept of conservation laws, homogeneity and isotropy	Theoretical formulation, Illustration, Lecture discussion	Quiz, short questions Problem solving
	3	D'Alemberts principle of virtual work - Lagrange's equation of motion - non holonomic systems	3	To formulate Lagrange's equation of motion using D'Alembert' s principle	Theoretical formulation, Illustration, Lecture discussion, PPT	Formative assessment
	4	velocity dependent potential - Dissipative force – Newtonian and Lagrangian Formalism	4	To understand the Newtonian and Lagrangian formalism	Illustration, Theoretical formulation, Lecture discussion	Deriving theoretical formulas Short test
II	Hamilton's Equation and Canonical Transformation					
	1	Calculus of variation - Principle of least action - Hamilton's principle - Hamilton`s function	4	To formulate Hamilton's function using Hamilton's principle	Illustration, PPT, theoretical formulation	Evaluation through: multiple choice questions
	2	Lagrange's equation from Hamilton's principle - Hamilton's	3	To derive Lagrange's equation from	Illustration, PPT, theoretical formulation	Quiz, short questions

		principle for non holonomic system		Hamilton's principle		Problem solving
	3	Variational principle - Hamilton's equations from variational principle - Legendre transformation and Hamilton's equation of motion	4	To understand the concept of variational principle and derive Hamilton's equation from variational principle	Lecture discussion, Illustration, PPT, theoretical formulation	Formative assessment
	4	Canonical transformations- Hamilton's canonical equations - Generating functions- Examples - Poisson brackets and its properties.	4	To understand the concept of canonical transformation and poisson bracket	Illustration, Lecture discussion, theoretical formulation	Deriving theoretical formulas Short test
III	**Hamilton-Jacobi Theory and Small Oscillations**					
	1	Hamilton-Jacobi equation for Hamilton's principal function - Example: Harmonic oscillator problem	4	To derive the Hamilton-Jacobi equation for Hamilton's principal function and to solve the Harmonic oscillator problem.	Illustration, theoretical formulation, Lecture discussion	Evaluation through: multiple choice questions Quiz, short questions
	2	Hamilton's characteristic function -	3	To formulate the Hamilton's	Illustration, PPT, theoretical formulation	

		Action - Angle variable		characteristic function and explain the Action - Angle variable		Problem solving
	3	Application to Kepler problem in action angle variables. Eigen value equation	4	To analyze the application to Kepler problem in action angle variables; To solve Eigen value equation.	Illustration, theoretical formulation, Lecture discussion	Formative assessment
	4	Normal coordinates - Normal frequencies of vibration – Free Vibrations of linear tri atomic molecule.	4	To discuss the Normal coordinates and Normal frequencies of vibration and to derive the normal frequencies of free vibrations of linear tri atomic molecule.	Illustration, PPT, theoretical formulation	Deriving theoretical formulas Short te**st**
IV	**Kinematics of Rigid Body**					
	1	Independent coordinates of rigid body - Orthogonal transformation - Properties of transformation matrix	4	To understand the concept of Independent coordinates of rigid body. To derive the Orthogonal transformation and Properties of transformation matrix	Illustration, theoretical formulation, Lecture discussion	Evaluation through: multiple choice questions Quiz, short questions
	2	Euler angle and Euler's theorem - Infinitesimal	3	To derive Euler angle and Euler's theorem. To	Illustration, PPT, theoretical formulation	Problem solving

		rotation - Coriolis force		understand the concept of Infinitesimal rotation and Coriolis force.		Formative assessment
	3	Angular momentum and kinetic energy of motion about a point - Moment of inertia tensor - Euler's equations of motion	4	To derive the relation between the angular momentum and kinetic energy of motion about a point. To derive the Moment of inertia tensor and Euler's equations of motion.	Illustration, theoretical formulation, Lecture discussion	Deriving theoretical formulas Short test
	4	Force free motion of a symmetrical top - Heavy symmetrical top with one point fixed	4	To analyze the torque free motion of a symmetrical top and to discuss the heavy symmetrical top with one point fixed.	Illustration, PPT, theoretical formulation	
V	**Central Force Problem and Theory of Relativity**					
	1	Reduction to the equivalent one body problem- Centre of mass- Equation of motion and first integral- classification of orbits	3	To derive the reduced mass of the equivalent one body problem. To understand the concept of Centre of mass, Equation of motion and first integral. To discuss	Illustration, theoretical formulation, Lecture discussion	Evaluation through: multiple choice questions Quiz, short questions

				the classification of orbits based on the eccentricity.		Problem solving
	2	Kepler problem: Inverse-Square law of force - Scattering in a central force field - Transformation of scattering to laboratory coordinates.	4	To derive the Kepler problem: Inverse-Square law of force. To understand the concept of Scattering in a central force field. To transfer the scattering to laboratory coordinates.	Illustration, theoretical formulation, Lecture discussion	Formative assessment Deriving theoretical formulas
	3	Virial theorem – Lorentz transformation - Relativistic Mechanics - Relativistic Lagrangian and Hamiltonian for a particle	4	To understand the Virial theorem. To derive the Lorentz transformation. To understand the concepts of Relativistic Mechanics and to derive the Relativistic Lagrangian and Hamiltonian for a particle.	Illustration, PPT, theoretical formulation, Lecture discussion	Short test
	4	Mass in Relativity - Mass and energy – Space-time diagram – Momentum vectors	4	To understand the concept of mass in relativity. To discuss the relation between	Illustration, PPT, theoretical formulation, Lecture discussion	

				Mass and energy; To analyze Space-time diagram and to derive the Momentum vectors.		

CO- Course Outcome; CL-Cognitive Level; R- Remember; U- Understand; Ap- Apply; C - Create.

Course Instructors: Dr.M.Priya Dharshini and Ms.S.Virgin Jeba

Semester I

Course Name: Mathematical Physics

Course Code: PP2012

No. of hours per week	No. of credits	Total No. of hours	Marks
6	4	90	100

Objectives

1. To emphasize the use of mathematical tools like evaluation of definite integrals in the field of classical and quantum mechanics.

2. To demonstrate competence with a wide variety of mathematical techniques to enhance problem solving skills.

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	apply the various theorems in complex analysis to evaluate definite integrals.	PSO - 4	E
CO - 2	determine the series solutions and the recurrence relations (Bessel, Legendre and Hermite differential equations) and solve problems associated with them.	PSO - 3	E
CO - 3	discuss the basic principles and methods used for the analysis of partial differential equations and apply the techniques to related problems.	PSO - 4	C
CO - 4	discuss the concepts of Fourier, Laplace and inverse Laplace transform, tensors, group theory and their properties.	PSO - 5	C
CO - 5	develop expertise in mathematical techniques required in physics and to enhance problem solving skills.	PSO - 6	An

Modules

Credit:4 **Total Hours:90 (Incl. Seminar & Test)**

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assesment /Evaluation
I	**Complex Analysis**					
	1	Functions of Complex variable- Analytic functions – Cauchy – Riemann equations in cartesian and polar forms – Harmonic functions - Cauchy's integral theorem	4	To be able to identify the analytic functions by using the Cauchy's Riemann equations	PPT, Theoretical formulation and Problem solving	Evaluation through: Online quiz, through Google Classroom Assignments on Problem solving Short questions Descriptive answers Formative assessment
	2	Cauchy's integral formula – Taylor's Series – Laurent series	3	To be able to evaluate the integrals using Cauchy's formula and able to apply the series in computational science and approximation	Analysis and Problem solving	
	3	Cauchy's residue theorem – Singular points of an Analytic function – Evaluation of residues - application to evaluation of definite integrals –	4	To be able to apply the Cauchy's Residue theorem to evaluate the definite integrals of analytic functions	Analysis and Problem solving	
	4	Integration around a unit circle –Jordan's Lemma.	3	To be able to apply the Jordan's lemma to evaluate contour integrals	Analysis and Problem solving	
II	**Polynomials**					
	1	Legendre differential equation and Legendre functions – Generating functions	4	To acquire basic understanding of the partial differential equations and learn some	Analysis and Problem solving	Evaluation through: Online quiz, through Google Classroom

				methods for solving them.		Assignments on Problem solving Short questions Descriptive answers Formative assessment
	2	Rodrigue's formula – Orthogonal Properties - recurrence formula	3	To accomplish operations with differential equations along with the recurrence formulae	Analysis and Problem solving	
	3	Bessel differential equation – Bessel functions of I kind - recurrence formula and generating functions	4	To execute operations with Bessel differential equations	Analysis, Problem solving and comparative study	
	4	Hermite differential equations and Hermite polynomials - Generating functions & recurrence formula.	3	To carry out operations with Hermite differential equations along with the recurrence formulae	Analysis, Problem solving and comparative study	
III	**Differential and Partial Differential equations**					
	1	Homogeneous linear equations of second order with constant coefficients and their solutions	3	To be able to solve second order Homogenous differential equations	Analysis and Problem solving	Evaluation through: Online quiz, through Google Classroom Assignments on Problem solving Short questions Descriptive answers Formative assessment
	2	Ordinary second order differential with variable coefficients and their solution by power series and Frobenius methods	4	To be able to apply the power series and Frobenius methods to evaluate the solution of second order differential equations	Analysis and Problem solving	
	3	Solution of Laplace equation in Cartesian coordinates- Solution of heat flow equations	3	To be able to solve boundary value problems occur in steady state temperatures and of hydrodynamics	Analysis and Problem solving	
	4	Method of separation of variables – variable linear flow – One and two dimensional heat flow.	4	To be able to solve problems for heat flow	Analysis and Problem solving	

				equations in different dimensions under certain boundary conditions		
IV	**Tensors, Fourier and Laplace transforms**					
	1	Contravarient and Covarient Tensors - Addition and Subtraction – Outer product - inner product of tensors	3	To be able to solve mathematical problems involving tensors	Analysis and Problem solving	Evaluation through: Online quiz, through Google Classroom Assignments on Problem solving Short questions Descriptive answers Formative assessment
	2	Contraction of a tensor - Symmetric and anti-symmetric tensors – The Kronecker delta	3	To be equipped to use tensor algebra as a tool in the field of applied sciences	Analysis and Problem solving	
	3	Fourier transform- properties of Fourier transform - Fourier transform of a derivative	4	To be able to understand and apply the concept of Fourier transform to waveforms and spectra.	Analysis and Problem solving	
	4	Laplace transform- properties of Laplace transform- Inverse Laplace Transform.	4	To be able to use the Laplace transform equations for solving boundary value problems by directly changing the ordinary differential equations into algebraic equations.	Analysis and Problem solving	
V	**Group theory**					
	1	Group postulates – Abelian group – Cyclic group – Group multiplication table – Rearrangement theorem – Subgroups	3	To understand the mathematics of group theory	Descriptive lecture, Analysis and Problem solving	Evaluation through: Online quiz, through Google Classroom Assignments on Problem solving
	2	Isomorphism and Homomorphism – Symmetry elements and symmetry operations	4	To understand the symmetry and point group of molecules	Descriptive lecture, Analysis and Problem solving	

	3	Reducible and irreducible representations	3	To generate a representation and to reduce it to its irreducible representation	Descriptive lecture Analysis and Problem solving	Short questions
	4	The great orthogonality theorem - Character table for C_{2V}& C_{3V} point groups.	4	To determine the irreducibility of a reducible representation	Descriptive lecture Analysis and Problem solving	Descriptive answers Formative assessment

PO- Program outcome; LO – Learning outcome;
Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Semester: I

Course Name: QUANTUM MECHANICS -I
Course code: PP2013

No. of hours per week	No. of credits	Total No. of hours	Marks
6	5	90	100

Objective

To help the students to acquire understanding of the fundamental concepts and mathematical tools necessary to solve the wave equations.

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	summarize the concept of wave function and the postulates of quantum mechanics.	PSO-1	U
CO - 2	formulate time dependent and time independent equation and solve them for simple potentials.	PSO-4	C
CO - 3	evaluate the eigen values and eigen function spin and total angular momenta and determine the matrices.	PSO-4	E
CO - 4	analyze the principles of quantum theory, equation of motion, scattering theory and angular momentum.	PSO-4	An

Modules

Credit:5 **Total Hours:90 (Incl. Seminar & Test)**

Unit	Section	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Foundations of Wave Mechanics**					

		Wave packet – Time dependent Schrödinger equation – Interpretation of the wave function	4	To understand basic concepts of quantum mechanics by deriving group velocity, phase velocity and time dependent Schrodinger equation	PPT, Illustration and theoretical derivation	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment
		Admissibility conditions on the wave function – Hermitian operator – Postulates of quantum mechanics	4	To be able tounderstand the wave function and postulates of quantum mechanics	Illustration, Theoretical formulation Problem Solving	
		Simultaneous measurability of observables – General uncertainty relation – Ehrenfest's theorem	4	To analyze observables and their properties	PPT, Theoretical formulation and Problem solving	
II	**Eigen States and Many Electron Atoms**					
	1	Square-well Potential with Rigid Walls- Square Potential Barrier –Alpha Emision- Time independent Schrodinger equation	3	To understand the basic concepts and features related to Square-well Potential	PPT Illustration, lecture, and Problem solving	Evaluation through: Online quiz, short questions Descriptive answers Problem solving Formative assessment
	2	Time dependent Schrödinger equation – Stationary states - Eigen functions and eigen values	3	To relate time independent and time dependent Schrodinger equation	Descriptive lecturecomparative study	
	3	Kronig Penny square well periodic potential- Indistinguishable Particles- Particle Exchange Operator	3	Toformulate Kronig Penny square well periodic potential and operators	PPT, Theoretical formulation and Problem solving	

	4	Symmetric and Antisymmetric Wave Functions - Pauli Principle – Inclusion of spin	3	To understand Symmetric and Antisymmetric Wave Functions	Illustration, Theoretical formulation and Problem solving	
III	**Exactly Soluble Eigen value Problems**					
	1	One dimensional linear harmonic oscillator – operator method - Particle moving in a spherically symmetric potential	3	To solve the one-dimensional linear harmonic oscillator problem	Illustration, Theoretical formulation and Problem solving	Evaluation through: Online quiz, short questions Descriptive answers Assignment on applications Formative assessment
	2	Spherical harmonics- Radial equation- Rigid rotator- Hydrogen atom- solution of the radial equation	2	To formulate radial equations of hydrogen atom	PPT, Illustration,Theoretical formulation and Problem solving	
	3	Energy eigen values- Radial wave functions- Wave functions of hydrogen-like atom	3	To understand the eigen values and wave functions	Illustration, Theoretical formulation and Problem solving	
	4	Radial Probability density- Three-Dimensional square-well potential.	4	To formulate three-Dimensional square-well potential.	Illustration, Theoretical formulation comparative study and Problem solving	
IV	**Matrix Formulation of Quantum Theory, Equation of Motion & Angular Momentum**					
	1	Linear vector space- Dirac's notation-Equation of motions	2	To derive equation of motion using Quantum mechanical concepts	Theoretical formulation	Evaluation through: Online quiz, short questions Descriptive answers Problem solving Formative assessment
	2	Schrodinger, Heisenberg and Interaction representation.	2	To compare representation of equation of motion	Theoretical formulation	
	3	Angular momentum operators – Angular momentum commutation relations – Eigen values and eigen functions of L^2 and L_z	2	To understand the basic concepts and features related to Angular momentum	PPT Illustration, lecture, and Problem solving	

	4	General angular momentum – Eigen values of J^2 and J_z	2	To relate angular momentum and general angular momentum	Descriptive lecture comparative study	
	5	Angular momentum matrices – Spin angular momentum – Spin vectors for spin-(1/2) System	2	To formulate angular momentum matrices	Theoretical formulation and Problem solving	
	6	Addition of angular momentum: Clebsch-Gordon coeffiecients	2	To obtain C-G coefficient from angular momentum	Illustration,Theoretical formulation and Problem solving	
	7	Stern Gerlach Experiment.	1	To prove concept of spin experimentally	Demonstration	
V	**Scattering theory**					
	1	Scattering cross-section – Scattering amplitude	1	To understand the basic	PPT Illustration,	
				concepts and features related to scattering	And Descriptive lecture	Evaluation through: Online quiz,
	2	Partial waves – Scattering by a central potential: Asymptotic solution.	3	To understand the concept of partial waves	Descriptive lecture and Theoretical formulation	short questions
	3	Optical theorem- Ramsauer-Townsend effect- Partial wave analysis	2	To apply the concept of partial waves	Descriptive lecture and Theoretical formulation	Descriptive answers
	4	Scattering by an attractive square-well potential – Breit-Wigner Formula - Scattering length - Expression for phase shifts - Integral equation	3	To apply scattering theory to physical problems	Descriptive lecture and Theoretical formulation	Problem Solving
	5	The Born approximation – Scattering by screened coulomb potential – validity of Born approximation	2	To understand Born approximation	Descriptive lecture and Theoretical formulation	Formative assessment

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Staff –in –charge :Ms.Sonia & Ms.Aji Udhaya

Semester I

Course code: Numerical Methods

Course code: PP2016

No. of hours per week	No. of credits	Total No. of hours	Marks
6	4	90	100

Objective

To understand various numerical methods used to solve the physical problems.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO- 1	understand the various interpolation methods and finite difference concepts	PSO - 1	U
CO- 2	analyze the numerical solutions of linear and non linear equations	PSO - 4	An
CO- 3	utilize various numerical methods for differentiation and integration	PSO - 4	Ap
CO -4	discuss the concepts of ordinary differential equations	PSO - 5	C

Modules

Credit:4 **Total Hours:90 (Incl. Seminar& Test)**

Unit	Section	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/Evaluation
I	**Interpolation**					
	1.	Introduction, Polynomial Forms, Linear interpolation.	4	To understand the basic concepts of interpolation	PPT, Illustration and theoretical derivation	Evaluation through: Online quiz, Problem solving short
	2.	Lagrange Interpolation Polynomial, Newton Interpolation Polynomial	4	To be able to solve the problems of Lagrange and Newton Interpolation	Illustration, Theoretical formulation Problem Solving	

	3.	Divided difference table, Interpolation with equidistance points, Spline interpolation	4	To solve the problems of Divided difference table, Interpolation with equidistance points, Spline interpolation	PPT, Theoretical formulation and Problem solving	questions Descriptiv e answers Formative assessment
II	**Roots Of Nonlinear Equations**					
	1	**15 Hours** Introduction, Methods of Solution, Iterative Methods, Starting and Stopping an Iterative Process, evaluation of Polynomials	3	To understand the basic concepts of Iterative Methods	PPT Illustration, lecture, and Problem solving	Evaluation through: Online quiz, short questions Descriptiv e answers Problem solving Formative assessment
	2	Bisection method, False Position Method, Newton- Raphson Method	3	To solve various methods like Bisection, False Position and Newton-Raphson Method	Descriptive lecture solving problems	
	3	Secant Method, Fixed Point Method	3	To find the roots using Secant and Fixed Point Method	PPT, Theoretical formulation and Problem solving	
	4	Determining All Possible Roots.	3	To determine all Possible roots for the Polynomial equation	Illustration, Theoretical formulation and Problem solving	
III	**Solutions of Linear Equations**					

	1	**15 Hours** Need and Scope, Existence of Solutions, Solution by Elimination,	3	To understand the basics of elimination method	Illustration, Theoretical formulation and Problem solving	Evaluation through: Online quiz, short questions Descriptiv e answers Assignmen t on applicatio ns Formative assessmen t
	2	Basic Gauss Elimination Method, Gauss Elimination with Pivoting, Gauss- Jordan Method	2	To solve the problems of Gauss Elimination, Gauss Elimination with Pivoting and Gauss-Jordan Method	PPT, Illustration, Theoretical formulation and Problem solving	
	3	Triangular Factorization Methods, Round-off Errors and Refinement, Ill- Conditioned Systems,	3	To understand the Triangular Factorization Methods and Round-off Errors	Illustration, Theoretical formulation and Problem solving	
	4	Matrix Inversion Method, Jacobi Iteration Method, Gauss Seidel Method.	4	To solve the problems of Matrix Inversion Method, Jacobi Iteration Method and Gauss Seidel Method.	Illustration, Theoretical formulation comparative study and Problem solving	
IV	**Numerical Differentiation and Integration**					
	1	Numerical Differentiaton: Need and Scope, differentiatig continuous functions,	4	To understand the basic concepts of Numerical Differentiation	Theoretical formulation and Problem solving	Evaluation through: Online quiz, short questions Descriptiv e answers Problem solving
	2	Differentiating tabulated functions, Difference tables, Numerical Integration.	4	To solve problems for Difference tables and study the basics of Numerical Integration.	Theoretical formulation and Problem solving	

	3	Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Higher Order Rules.	4	To solve problems using Trapezoidal Rule, Simpson's 1/3 Rule and Simpson's 3/8 Rule	PPT Illustration, lecture, and Problem solving	Formative assessment
V	**Numerical Solutions of Ordinary Differential Equations**					
	1	**15 Hours** Need and Scope, Tailor Series Method – Improving accuracy,	3	To understand the basic concepts and features of Tailor Series	PPT Illustration, And problem solving	Evaluation through: Online quiz, short questions Descriptiv e answers Problem Solving Formative assessment
	2	Picard's method, Euler's Method – accuracy of Euler's method, .	3	To solve differential Equations using Picard's, Euler's Method , Euler's method,	problem solving	
	3	Heun's Method – Error analysis, Polygon Method,	3	To apply the concept of Heun's Method , Error analysis, Polygon Method to solve the equations	PPT Illustration, And problem solving	
	4	Runge-Kutta Methods- Determination of weights, Fourth order Runge-Kutta methods.	3	To apply Runge-Kutta Methods to solve the problems	PPT Illustration, And problem solving	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C-Create

Staff-in charge: Ms.Shally & Ms.Lesly

Semester II

Course Name: Electromagnetic Theory

Course code: PP2021

No.of hours per week	No. of credits	Total No .of hours	Marks
6	4	90	100

Objectives

1. To provide knowledge on the propagation of electromagnetic radiation

2.To develop theoreticalknowledge,skillsonsolvinganalyticalproblemsinelectromagnetism.

CO	Upon completion of this course, students will be able to	PSO addressed	CL
CO -1	Summarize the fundamental laws of electrodynamics based On Maxwell's equations.	PSO-1	U
CO -2	Enumerate the concept of energy in electrostatic and Magnetostatic fields.	PSO-2	K
CO -3	Illustrate the electrical properties of materials; solve the Wave equation as plane waves in source.	PSO-5	Ap
CO -4	Analyze the wav epolarization and reflection/transmission of Plane waves in homogenous media.	PSO-4	An

Teaching Plan

Credits: 4 **Total Hours: 90 (Incl. Seminar &Test)**

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	Electrostatics					
	1	Coulomb's law; the electric field – line, flux and Gauss's Law in differential form - theelectrostatic potential; conductors and insulators	4	Understand the concepts Electrostatic field and basicequations	PPT, Descriptive lecture	Evaluation through: quiz, Problem

	2	Gauss's law - application of Gauss's law –curl of E - Poisson's equation; Laplace's equation	3	To understand the divergence and curl of E and its applications	Illustration, Descriptive lecture	solving Descriptive answers
	3	work and energy in electrostatics – energy of a point charge distribution – energy of continuous charge distribution – inducedcharges – capacitors.	4	Understand the basic concept of energy of a point charge and continuous charge distribution	Videos, group discussion	short questions
	4	Potentials: Laplace equation in one dimension and two dimensions –Dielectrics – induceddipoles– Gauss'sLawinthepresence ofdielectrics.	4	Solve solution of Laplace's equation in one and two dimension and understand the electric fields conductors and dielectrics	Seminar, Lecture	Formative assessment (I CIA)
II	Magnetostatics					
	1	Lorentz force – magnetic fields – magnetic forces – currents – Biot-Savart Law – divergenceand curl of B	4	Understand the concept of magnetic fields, Biotsavart's law for a	PPT Illustration, Descriptive	Evaluation through: quiz,
				line current	lecture	
	2	Ampere's Law – Electromagnetic induction - comparison of magnetostaticsand electrostatics –	4	To acquire knowledge on ampere's law and magnetic vector potential	Lecture ,Videos	short questions Descriptive answers
	3	Magnetic vector potential- Magnetization: effect of magnetic field onatomicorbit–	4	To understand the effect of magnetic field on atomic orbit	Descriptive lecture	Problem solving
	4	Ampere'sLawin magnetizedmaterials– ferromagnetism.	3	Understand the ampere's law in magnetized materials	Descriptive lecture, seminar	Formative assessment (I&II CIA)

III	ElectromotiveForce					
	1	Ohm's Law – electromotive force – motional emf – Faraday's Law –	4	Understand t	Illustrati on, Descripti ve lecture	Evaluation through: quiz, short questions Descriptive answers Formative assessment (I CIA)
	2	induced electric field –inductance– energyinmagneticfield	3			
	3	Maxwell'sequationinfreespacean dlinearisotrophicmedia– continuityequation – Poyntingtheorem.	4	Solve the Maxwell's equations and pointing theorem	Descripti ve lecture	
	4	Waves in one dimension – wave equation – sinusoidalwaves – reflectionandtransmission– Polarization.	4	Solve the wave equation. Reflection, transmission and polarization	Group Discussi on, Lecture, seminar	
IV	ElectromagneticWaves					
	1	The wave equation for E and B – Monochromatic Plan waves – energy and momentum inelectromagnetic waves–	5	Understand the Wave equation, energy for E and B. Explain the electromagnetic waves in matter	PPT Illustrati on, Descripti ve lecture.	Evaluation through quiz, Descriptive answers short questions Assignment Formative assessment (II CIA)
	2	electromagnetic waves in matters -TE waves in rectangular waveguides – the co-axial transmission line	5	Explain in brief the reflection and transmission at normal incidence and oblique incidence	Lectur e, Group discussi on	
	3	Potentials: potentials and fields – scalar and vectorpotentials – Gauge transformation – Coulomb Gauge and Lorentz Gauge – Lorentz force lawinpotentialform.	5	Understand the concept of Coulomb gauge and Lorentz gauge	Lectu re, semin ar	

V	Application ofElectromagneticWaves					
	1	Boundary conditions at the surface of discontinuity – Reflection and refraction of E.M wavesat the interface of non – Conducting media	4	Understand the concept of four vectors, Minkowski force	PPT Illustration, Descriptive lecture	Evaluation through: quiz, short questions
	2	Kinematic and dynamic properties – Fresnel'sequation – Electric field vector 'E' parallel to the plane of incidence and perpendicular to theplane of incidence	4	To acquire knowledge on the Maxwell's equations in four vector form.	Descriptive lecture	Descriptive answers Problem solving
	3	Reflection and transmission co-efficients at the interface between twonon–Conductingmedia	4	To acquire knowledge on theLagrangianand Hamiltonian force equations	Descriptive lecture, Seminar, Assignment	Formative assessment (II CIA)
	4	Brewster'slawanddegreeofpolarization–Totalinternalreflection.	3	Understand the brewster's law and degree of polarization	Illustration, Descriptive lecture	

PO- Program outcome; LO – Learning outcome; Cognitive Level U – Understand; Ap- Apply, An- Analyze; K-Knowledge

Course Instructor : Ms. S. Virgin Jeba

Semester : II
Name of the Course : QUANTUM MECHANICS –II (Core – V)
Subject code : PP2022

No. of hours per week	No. of credits	Total No. of hours	Marks
6	5	90	100

Objective

To develop several approximation methods, for bounds states and scattering states and apply them to illustrative problems.

CO	Upon completion of this course, students will be able to:	PSO addressed	CL

CO - 1	enumerate time independent perturbation theory and use approximation methods. (variation principle and WKB method) to solve simple problems (ground state helium, barrier penetration, etc)	PSO-1	K
CO - 2	analyze time dependent perturbation theory to discuss absorption and emission of radiation for harmonic perturbation.	PSO-6	An
CO - 3	interpret quantum theory of atomic and molecular structure.	PSO-4	U
CO -4	formulate Klein-Gordan and Dirac equations and discuss the applications. (particle in a Coulomb field, Spin of electron)	PSO-1	C

Modules

Credit: 5 **Total Hours: 90 (Incl. Seminar & Test)**

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Approximation Methods for Time Independent Problems**					
	1	Time independent perturbation theory: Basic concepts – Non-degenerate energy levels – first and second order	4	To understand the basic concepts of time independent perturbation theory.	PPT, Illustration and theoretical derivation	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment
	2	Anharmonic oscillator – First-order correction – Ground state of Helium	3	To understand the ground state of Helium.	Illustration, Theoretical formulation Problem Solving	
	3	Effect of electric field on the ground state and n=2 of hydrogen	4	To analyze the effect of electric field on hydrogen.	Illustration, Theoretical formulation Problem Solving	
	4	Degenerate Energy Levels-Stark effect in hydrogen molecule-Spin-Orbit interaction.	4	To analyze the splitting of energy levels in hydrogen molecule and spin-orbit interaction.	PPT, Theoretical formulation and Problem solving	
II	**Approximation Methods for Time Dependent Perturbation Theory**					

	1	Time dependent perturbation theory: First order perturbation – Harmonic perturbation – Transition to continuum states- Fermi Golden Rule	4	To understand the basic concepts and features related to time dependent perturbation.	PPT Illustration, lecture, and Problem solving	Evaluation through: Online quiz, short questions Descriptive answers Problem solving Formative assessment
	2	Absorption and Emission of radiation – The Electromagnetic field	4	To understand the absorption and emission of electromagnetic radiation.	Descriptive lecture, comparative study	
	3	Hamiltonian operator- Electric dipole approximation- transition probability	4	To formulate the electric dipole approximation.	PPT, Theoretical formulation and Problem solving	
	4	Einstein's A and B coefficients – Selection rules- forbidden transitions.	3	To understand selection rules and forbidden transitions.	Illustration, Theoretical formulation and Problem solving	
III	**Variation and WKB Method**					
	1	Variation method :Variational principle – Ground state of Helium and Deuteron	4	To solve the ground state of Helium and Deuteron.	Illustration, Theoretical formulation and Problem solving	Evaluation through: Online quiz, short questions Descriptive answers Assignment Formative assessment
	2	WKB Approximation : WKB method – Connection formula – Solution near a turning point – Validity of the WKB method	4	To analyze the WKB approximation.	PPT, Illustration,Theoretical formulationand Problem solving	
	3	Barrier penetration – Alpha emission	4	To understand applications of WKB method.	Illustration, Theoretical formulation and Problem solving	
	4	Bound states in a potential well	3	To analyze the bound states in a potential well.	Illustration, Theoretical formulation comparative	

					study and Problem solving	
IV	**Quantum Theory of Atomic and Molecular Structure**					
	1	Spin functions – Helium atom- Ground state- First excited state	3	To understand the concept of spin functions of two and three electrons.	Theoretical formulation and Problem solving	Evaluation through: Online quiz, short questions Descriptive answers Problem solving Formative assessment
	2	Central field approximation: - Determination of central field: Thomas Fermi method- Hartree-Fock approximations	5	To compare the central field approximations.	Theoretical formulation and Problem solving	
	3	Molecular Orbital method- Born-Oppenheimer approximation – MO treatment of hydrogen molecule Ion (H_2+)	5	To understand the basic concepts and features of molecular orbital method.	PPT Illustration, lecture, and Problem solving	
	4	Molecular orbital theory of Hydrogen molecule.	2	To analyze the molecular orbital theory of hydrogen molecule.	Descriptive lecture comparative study	
V	**Relativistic Quantum Mechanics & Quantization of the Field**					
	1	Klein – Gordon Equation – Interpretation of the Klein-Gordon equation – Particle in a Coulomb field	4	To understand the basic concepts and features of a particle in a Coulomb field.	PPT Illustration, And Descriptive lecture	Evaluation through: Online quiz, short questions Descriptive answers Problem
	2	Dirac's equation for a free particle – Dirac matrices – Plane wave solution –Negative energy states – Spin of the Dirac particle	4	To understand the concept of Dirac particle.	Descriptive lecture and Theoretical formulation	
	3	Magnetic moment of the electron – Spin-orbit interaction.	2	To apply the concept of magnetic	Descriptive lecture and Theoretical	

				moment of electron.	formulation	Solving
	4	Quantization of the Field - Lagrangian equation- Hamiltonian equation- Schrodinger equation- Quantization of Electromagnetic fields	5	To understand the quantization of the field.	Descriptive lecture and Theoretical formulation	Formative assessment

PO- Program outcome; LO – Learning outcome; Cognitive Level : K- Knowledge; Analyze- An; U – Understand; Create – C.

Course Instructor: Dr. M.Priya Dharshini & Dr.S.Sonia

Semester II
Major Core –VI
Name of the Course : Condensed Matter Physics-I
Subject code : PP2023

No of hours per week	No of credits	Total no of hours	Marks
6	4	90	100

Objective

To give strong foundation in the conceptual understanding of the development of solid state physics with appropriate theoreticalbackground.

CO	Upon completion of this course the students will be able to :	PSO addressed	CL
CO- 1	differentiate between different lattice types and explain the concepts of reciprocal lattice and crystal diffraction	PSO-4	Ap
CO- 2	analyze various crystal imperfections and ordered phases of crystal	PSO-2	An
CO- 3	explain the theory of lattice vibrations and analyze the thermal properties of solids	PSO-2	An
CO -4	formulate the problem of electrons in a periodic potential	PSO-1	U

Modules

Credits: 4 Total contact hours: 90 (Including assignments and tests)

Unit	Section	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
	Crystal Physics:CrystalStructure					
		Lattice representation, Simple symmetry operations, Bravais Lattices, Unit cell, Wigner - Seitz cell		To acquire knowledge on space lattice and symmetry operations	Lecture Discussion with PPT illustration	Evaluation through Online quiz Class test Formative assessment I
		Miller planes and spacing, Characteristics of cubic cells, Structural features of NaCl, CsCl, Diamond, ZnS, Closepacking.		To be able to identify the crystal structure of materials	Lecture discussion with illustration, SLO	
		Crystal Binding*:* Interactions in inert gas crystals and cohesive energy, Lennard - Jones potential, Interactions in ionic crystals and Madelung energy		To understand the different kinds of bonding	Lecture discussion	
		valent bonding , Heitler - London Theory Hydrog en bonding , metallic bonding .		To acquire knowledge on hydrogen, metallic and mixed bonding	Lecture discussion, PPT	
	Diffraction of Waves and Particlesby Crystals					
		X-rays and their generation,		To know the principles	Lecture Discussion	Short test

		Moseley's law, Absorption of X-rays (Classical theory), Absorption Edge, X-ray diffraction		involved in X-ray diffraction	with PPT Illustration	Quiz Assignment Formative assessment I
		The Laue equations, Equivalence of Bragg and Laue equations, Interpretation of Bragg equation, Ewald construction		To understand the equivalence of Bragg and Laue equations	Lecture discussion	
		Reciprocal lattice, Reciprocal lattice to SC, BCC and FCC crystals, Importance properties of the Reciprocal lattice –		To be able to draw the reciprocal lattice to SC, BCC and FCC crystals	Lecture Illustration	
		Diffraction Intensity, The Powder method, Powder Diffractometer, The Laue method, The Rotating Crystal method, Neutron Diffraction, Electrondiffraction		To acquire knowledge on Neutron Diffraction and Electrondiffraction		
	Crystal Imperfections and Ordered PhasesofMatter					
		Point imperfections, Concentrations of Vacancy, Frenkel and Schottky imperfections		To evaluate the different imperfections involved in crystal	Lecture with PPT Illustration	Evaluation through Online quiz Assignment Formative assessment II
		Line Imperfections Burgers Vector, Presence of dislocation, surface imperfections, Polorans,Excitons.		To understand the concept dislocation	Question-answer session Lecture	
		Ordered phases of		To acquire	Lecture	

		matter: Translational and orientation order - Kinds of liquid crystalline order - Quasi crystals - Superfluidity.		knowledge on Ordered phases of matter	discussion with illustration, SLO	
	LatticeDynamics					
		Theory of elastic vibrations in mono and diatomic lattices, Phonons, Dispersion relations, Phonon momentum		To understand the concept lattice vibration and derive the dispersion relation	Lecture Discussion	Evaluation through Online quiz Formative assessment II
		Heat Capacity: Specific heat capacity of solids, Dulong and Petit's law, Vibrational modes		To acquire knowledge on phonon heat capacity	Lecture Discussion	
		Einstein model, Density of modes in one and three dimensions, Debye Model of heat capacity, Anharmonic Effects: Explanation for Thermal expansion, Conductivity and resistivity, Umklapp process.		To be able to determine the density of states	Brain storming session. Lecture Illustration	
	TheoryofElectrons					
		Energy levels and Fermi-Darac distribution for a free electron gas, Periodic boundary condition and free electron gas in three dimensions		To have clear idea about Fermi-Darac distribution for a free electron gas	Lecture with PPT	Short test Formative assessment III
		Heat capacity of the electron gas, Ohm's law, Matthiessen's rule, Hall effect and magnetoresistance,Wiedemann - Franz law, Nearly free electron model and		To acquire knowledge on Heat capacity of the electron gas and Bloch function	Brain storming session. Lecture Illustration	

		the origin and magnitude of energy gap, Bloch functions, Bloch theorem				
		Motion of an electron in a periodic potential, Kronig - Penney model, Approximate solution near a zone boundary, Metals, semiconductors and insulators		To acquire knowledge on Motion of an electron in a periodic potential	Lecture with PPT Illustration	

PO- Program outcome; LO – Learning outcome; Cognitive Level U – Understand; Ap- Apply, An- Analyze;
Course instructors: Dr.A.Lesly Fathima and Sr.S.Sebastiammal

Semester II
Introductory Astronomy, Astrophysics & Cosmology (Elective – II (b))
Subject code: PP2025

No. of hours per week	No. of credits	Total no. of hours	Marks
6	5	90	100

Objectives:

The course enables the students to understand and realize the historical evolution of Universe and principles involved in Astrophysics.

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	perceive the historical evolution of solar system and universe.	PSO - 3	E
CO - 2	describe the principles of physics in the formation of astronomical objects like planets-satellites – asteroids and comets.	PSO - 1	U
CO - 3	gain experience with measurement techniques and equipment and develop the ability to assess uncertainties and assumptions.	PSO - 2	An
CO - 4	develop analytical skills and the ability to understand the astronomical situation.	PSO - 7	U
CO - 5	analyse the formation of binary stars, multiple stars, neutron stars and black holes.	PSO - 4	An
CO - 6	interpret the observations of galaxies, dark matter, quasars and pulsars.	PSO - 5	E
CO - 7	achieve a good understanding of physical laws and principles.	PSO - 6	C

Modules

Credit:5 **Total Hours:90 (Incl. Seminar & Test)**

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assesment/Evaluation
I	**History of Astronomy**					
	1	Introductory History of Astronomy- Ptolemy‟s Geocentric Universe-Copernicus‟ Heliocentric Universe	4	To understand basic concepts of Astronomy	Illustration and PPT	Evaluation through: quiz Formative assessment Evaluation through test Multiple choice questions
	2	Tycho Brahe and Galileo‟s Observations-Kepler‟s Laws ofPlanetary Motion-Newtonian Concept Of Gravity	3	To know the physical significance of Tycho Brahe and Galileo‟s Observations and Laws Physics	Illustration, PPT	
	3	Highlights of Einstein‟s Special and General Theory Of Relativity	4	To know the Highlights of Einstein‟s Special and General Theory of Relativity	Lecture Discussion	
	4	Curved Space Time-Evidence of Curved Space Time-Bending Of Light- Time Dilation	4	To have a knowledge on Bending of Light- Time Dilation	Lecture Discussion and Group Discussion	
II	**Stars & Galaxies**					
	1	Stars and Galaxies-Distances-Trigonometric Parallax-Inverse Square Law	3	To understand the basic concepts of Stars and Galaxies	Illustration and PPT, Videos	Evaluation through: quiz Formative assessment Evaluation through short answers
	2	Magnitude of Stars-Apparent Magnitude-Absolute Magnitude and Luminosity	4	Knowledge on Magnitude of Stars	Illustration and PPT, Videos	
	3	Color and Temperature-Composition of Stars-Velocity, Mass and Sizes of Stars-Types of Stars	4	To acquire knowledge on Color and Temperature-	Illustration , PPT, Lecture and Discussion	

				Types of Stars		
	4	Temperature Dependence-Spectral Types- Hertzsprung-Russell (HR) Diagram-Spectroscopic Parallax	4	To acquire a knowledge on Spectral Types and HR Diagram	Illustration , PPT, Lecture and Discussion	
III	**Lives And Death of Stars**					
	1	Stellar Evolution-Mass Dependence-Giant Molecular Cloud-Protostar-Main Sequence Star-Subgiant, Red Giant, Supergiant-Core Fusion	4	To understand the basic concepts of Stellar Evolution, Mass Dependence and Giant Molecular Cloud	Illustration , PPT, Lecture and Discussion	Evaluation through: quiz Formative assessment. Evaluation through: quiz,
	2	Red Giant (Or) Supergiant-Planetary Nebula(Or) Supernova-White Dwarfs-Novae And Supernovae-Neutron Stars-Pulsars	4	To acquire knowledge on Supernova-White Dwarfs-Novae And Supernovae-Neutron Stars-Pulsars	Illustration , PPT, Lecture and Discussion	
	3	Black Holes-Detecting Black Holes The Sun- Its Size and Composition- Sun‟s Interior Zones-Sun‟sSurface	4	To understand the basic concept of Black Holes and The Sun	Illustration , PPT and Videos	
	4	Photosphere-Chromosphere-Corona-Sun's Power Source-Fusion Reaction Mechanism.	3	To be able to distinguish between Photosphere-Chromosphere and Corona	Illustration , PPT and Videos	
IV	**Cosmology I**					
	1	Introduction to Cosmology-Basic Observations and implications-Olbers' Paradox - Expanding Universe	4	To understand the basic concepts of Cosmology	Illustration, Theoretical formulation	Evaluation through: quiz, Problem solving
	2	Gravitational Redshift-Doppler Effect-Hubble's Law and the	4	To understand and analyze the spectral shift	Illustration, Theoretical formulation	

		Age of the Universe			and Problem solving	Theoretical derivation Formative assessment
	3	Cosmological Principle-The Perfect Cosmological Principle- Observation and interpretation of Cosmic Microwave background Radiation (CMBR)	5	To understand and analyze the various Cosmological Principles	Descriptive lecture and Theoretical formulation	
	4	Evidence Supporting the General Big Bang Theory-Salient features of Steady State Theory	2	To understand and analyse the Big Bang theory and the Steady State theory	Descriptive lecture and Theoretical formulation	
V	**Cosmology II**					
	1	Fate of the Universe-Dependence on Mass (Curvature of Space)-Critical density-Open Universe-Closed Universe.	5	To understand basic concepts of the universe	Illustration, Theoretical formulation	Evaluation through: quiz, Problem solving Theoretical derivation Formative assessment
	2	Homogenous and Isotropic Freidman-Robertson-Walker Universes- Deriving the Geometry of the Universe from the Background Radiation	6	Understand and analyze the geometry of the universe	Illustration, and Problem solving	
	3	Flatness Problem-Horizon Problem-Inflation and its effect on the universe-The Cosmological Constant.	4	To understand and analyze the various cosmological problems	Illustration, Theoretical formulation	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An-

Analyze; E-Evaluate; C- Create
Course Instructor**:**Dr.V.Shally&Ms.S.J.Jenepha Mary

Semester: III
Course Name: Electronics
Course code: PP2031

Hours/Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To impart in depth knowledge about Semiconductors, diodes, Transistors, Operational Amplifiers, Memories and converters etc
2. To provide knowledge in the basic structure and working concepts of electronic devices.
3. To acquire application skills involving digital integrated circuit.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO 1	Understand the basic operation, and features related to diodes, transistor, op-amps, converter and interpret their applications	**PSO-1**	**U**
CO 2	Explain about the internal circuitry and logic behind semiconductor memory devices.	**PSO-2**	**U**
CO 3	Assess the working of diodes, transistor, op-amps and converters.	**PSO-3**	**E**
CO 4	Design various filter circuits.	**PSO-6**	**C**
CO 5	Interpret the Internal Architecture of memory devices	**PSO-4**	**An**

Modules
Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Section	Topics	Lecture Hours	Learning outcomes	Pedagogy	Assessment/Evaluation
I	**SemiconductorDiodes**					
	1	Introduction to Semiconductor - Intrinsic Semiconductor - Extrinsic Semiconductor	**4**	Define the basis of Semiconductor	PPT, Illustration and theoretical derivation, Circuit designing	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment I
	2	P-type- N-Type - PN Junction diode –Crystal Diode	**4**	Apply various junction diodes and Crystal Diode	Derivation and group discussion, Circuit designing	

	3	Zener diode- LED – Varactor Diode -Tunnel diode	**4**	Derivation of current voltage relations	PPT, Illustration, Theoretical formulation Circuit designing	
	4	Photo diode - schottky diode – Impatt diode- Characteristics and Applications.	**3**	ApplyCharacteristics and Applications.	Derivation and group discussion Circuit designing	
II	**Transistor Biasing and opto Electronic Devices**					
	1	Thevenin's and Norton's theorems	**4**	Solve Thevenin's and Norton's theorems	PPT, Derivation discussion Circuit designing	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment I
	2	Transistor action- PNP- NPN transistors – Transistor biasing and stabilization	**4**	Define and derive equations	Derivation and group discussion problem solving Circuit designing	
	3	Need for biasing- DC load line- operating point- Bias stability-	**3**	Statement and proof of operating point	Illustration, Theoretical formulation Circuit designing	
	4	Two port Network - Hybrid model – h parameters — JFET – UJT- SCR	**4**	Two port Network and its applications	Derivation and group discussion problem solving Circuit designing	
III	**Operational Amplifier Applications**					
	1	Operational Amplifier- CMRR-Slew rate - Instrumentation amplifier – V to	**4**	Analyse Operational Amplifier	Derivation discussion Circuit designing	Evaluation Evaluation through: Online quiz, Problem solving short questions

		I and I to V converter – Op-amp stages				Descriptive answers Formative assessment I/II
	2	Equivalent circuits - Sample and Hold circuits. Applications of Op-Amp: Inverting, Non-inverting Amplifiers-circuits	**3**	Define and derive Inverting ad Non-inverting Amplifiers	Illustration, Theoretical formulation Circuit designing	
	3	Adder-Subtractor-Differentiator-Integrator-Electronic analog Computation solving simultaneous and differential equation –. Schmitt Trigger – Triangular wave generator – Sine wave generator	**4**	Define and Derive Adder-Subtractor-Differentiator - Integrator	Derivation and group discussion, PPT Circuit designing	
	4	Active filters: Low, High and Band pass first and second order Butterworth filters – wide and narrow band reject filters.	**4**	Define, deriveand apply Active filters	PPT, Illustration, Theoretical formulation Circuit designing	
IV	**Semiconductor Memories**					
	1	Classification of memories and sequential memory – Static Shift Register and Dynamic Shift Register	**4**	Discuss different types ofmemories and sequential memory	Derivation discussion Circuit designing	Evaluation through: Online quiz, Problem solving short questions Descriptive answers

	2	ROM, PROM and EPROM principle and operation Read & Write memory - Static RAM, dynamic RAM, Content Addressable Memory	**3**	Define and derive principle and operation	Derivation and group discussion, PPT Circuit designing	Formative assessment II
	3	Content Addressable Memory - principle, block diagram and operation. Programmable Logic Array (PLA) - Operation, Internal Architecture	**4**	Define and Derive different types of Content Addressable Memory	Derivation and group discussion Circuit designing	
	4	Charge Couple Device (CCD) - Principle, Construction, Working and Data transfer mechanism.	**4**	Define , deriveand apply Charge Couple Device	Derivation and group discussion Circuit designing	
V	**A/D and D/A Converter**					
	1	Sampling theorem-Time division multiplexing – Quantization –	**3**	Analyse Fundamental Sampling theorem	Discussion PPT Circuit designing	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	DAC- Weighted resistor method – Binary Ladder network – ADC – successive approximation,	**4**	Analyse classification DAC	Derivation and group discussion, PPT Circuit designing	
	3	ADC Dual slope and Counter method	**4**	Explain ADC Dual slope and Counter method	Derivation and group discussion Circuit designing	

	4	Voltage to Frequency conversion and Voltage to Time conversion .	**4**	Define, deriveand apply Voltage to Frequency conversion	Derivation and group discussion, PPT Circuit designing	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Staff-in charge: Ms.C.Nirmala Louis & Ms.Jenepha Mary

Semester III

Course Name : Condensed Matter Physics - II

Course code: PP2023

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objectives

1. To develop analytical thinking to understand the phenomenon that decide various properties of solids thereby equip students to pursue higher learningconfidently.

Course Outcome

CO	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	Understand the theory of dielectrics and analyze the dielectric properties of materials.	PSO - 1	An
CO - 2	Explain various types of magnetic phenomenon and their properties and applications.	PSO - 4	E
CO - 3	Elaborate the properties and applications of superconductors.	PSO - 4	C
CO - 4	Apply the obtained concepts to challenges in condensed matter physics	PSO - 6	Ap

Modules

Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Section	Topics	Lecture Hours	Learning outcomes	Pedagogy	Assessment/Evaluation
I	**Theory of Dielectrics:**					
	1	Dipole moment - Polarization - The electric field of a dipole - Local electric field at an atom - Clausius - Mosottiequation - Dielectric constants and its measurements	**4**	To acquire knowledge on polarization and Dielectric constants	cture Discussion with PPT illustration	
	2	Polarizability - The Classical theory of electronic polarizability - Ionic polarizabilities - Orientational polarizabilities - The polarizability catastrophe	**4**	To be able to understand the ofelectronic polarizability - Ionic polarizabilities	cture discussion with illustration ,Derivation and group discussion	valuation through: Online quiz, lass test, Formative assessment I
	3	Dipole orientation in solids - Dipole relaxation and dielectric losses - Debye Relaxation time - Relaxation in solids	**4**	To be able to find out the Debye Relaxation time	PPTIllustration	

	4	Complex dielectric constants and the loss angle - Frequency and temperature effects on Polarization - Dielectric breakdown and dielectric loss	**3**	To understand the different Dielectric breakdown and dielectric loss.	Derivation and group discussion	
II	**Theory of Ferroelectrics and Piezo Electrics**					
	1	Ferroelectric Crystals - Classifications of Ferroelectric crystals - Dipole theory offerroelectricity - Landau Theory of the phase transition	**4**	To be able to classify Ferroelectric crystals	Lecture discussion with illustration	Evaluation through: Online quiz, Short questions, Descriptive answers, Formative assessment I
	2	Second order Transition - First Order Transition - Ferroelectric Transition - One-Dimensional Model of the Soft Mode of Ferroelectric Transitions	**4**	To understand the difference between first order transition and second order transition	Derivation and group discussion problem solving Circuit designing	
	3	Antiferroelectricity - Ferroelectric domains - Ferroelectric domain wall motion - Piezoelectricity	**3**	To acquire knowledge on Piezoelectricityand Ferroelectric domain wall motion	LectureIllustration,	
	4	Phenomenological Approach to Piezoelectric Effects - Piezoelectric Parameters and Their Measurements -	**4**	To understand the concept of Piezoelectric Parameters and Their Measurements	Lecture Discussion	

		Piezoelectric Materials				
III	**Magnetic properties of Materials:**					
	1	Terms and definitions used in magnetism - Classification of magnetic materials - Atomic theory of magnetism - The quantum numbers	**4**	To have clear idea about Classification of magnetic materials	Illustration, discussion	Evaluation through: Online quiz, Short questions, Descriptive answers, Formative assessment I/II
	2	The origin of permanent magnetic moments - Langevin's classical theory of diamagnetism - Sources of paramagnetism - Langevin's classical theory of paramagnetism - Quantum theory of paramagnetism	**3**	To acquire knowledge ondiamagnetism and paramagnetism	Derivation and group discussion	
	3	Paramagnetism of freeelectrons - Ferromagnetism - The Weiss molecular field - Temperature dependence of Spontaneous magnetization	**4**	To understand the concept of Paramagnetism of freeelectrons and Spontaneous magnetization	Derivation and group discussion,PPT Illustration	
	4	The physical origin of Weiss Molecular field - Ferromagnetic domains - Domain theory - Antiferromagnetis m - Ferrimagnetism - Structure ofFerrite	**4**	To be able to determine the Antiferromagnet ismand Ferrimagnetism	Derivation And Lecture Illustration	
IV	**Superconductivity:**					

	1	Occurrence of super conductivity - Destruction of super conductivity by magnetic fields - Meissner Effect - Type I and Type II Super conductors	**4**	To know the principlesof super conductivity and Meissner Effect	Derivation and discussion	Evaluation through: Online quiz, short questions, Descriptive answers, Formative assessment II
	2	Heat Capacity - Energy gap - Microwave and infrared properties - Isotope effect - Thermodynamics of the superconducting transition	**3**	To understand the differentMicrowave and infrared properties and Isotope effect	Derivation and PPT	
	3	London equation - Coherence Length - BCS theory of superconductivity, BCS groundstate- Fluxquantizationin asuperconductionring	**4**	Define and Derive London equation,Coherence Length and BCS theory of superconductivity	Derivation and group discussion	
	4	Durationofpersistencecurrents- Single particle tunnelling - DC Josephson effect - AC Josephson effect - Macroscopic quantum interference - High temperature super conductors - Applications	**4**	To Explain theSingle particle tunnelling, DC and AC Josephson effect	Derivation andgroup discussion	
V	**Physics of Nanosolids:**					
	1	Definition of nanoscience and nanotechnology - Preparation of nanomaterials - Surface to volume ratio	**3**	To acquire knowledge onnanoscience and nanotechnology and Preparation of nanomaterials	Discussion And Illustration with PPT	Evaluation through: Open book test, short questions, Descriptive answers,
	2	Quantum	**4**	To have clear	Derivation and	

		confinement - Qualitative and Quantitative description - Density of states of nanostructures		idea aboutDensity of states of nanostructures	group discussion	Formative assessment II
	3	Excitons in Nano semiconductors - Carbon in nanotechnology - Buckminsterfullere ne - Carbon nanotubes	**4**	To be able to determine theBuckminsterf ullerene and Carbon nanotubes	Lecture Illustration	
	4	Nano diamond - BN nano tubes - Nanoelectronics - Single electron transistor - Molecular machine - Nanobiometrics	**4**	To acquire knowledge on Single electron transistor and Nanobiometrics	Lecture discussion with illustration	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Course instructors: Dr. A. Lesly Fathima and Dr. (Sr). S. Sebastiammal

SEMESTER III

Course Name: MICROPROCESSORS AND MICROCONTROLLER

Course Code: PP2034

Hours/Week	**Credits**	**Total Hours**	**Marks**
6	**4**	**90**	**100**

Learning Objectives

1. To provide an extensive knowledge about the architecture and assembly language programming of microprocessors 8085 & 8086 and microcontroller 8051.
2. To gain hands on experience in interfacing of 8085 microprocessor.

Course Outcome

COs	**Upon completion of this course, students will be able to**	**PSOs addressed**	**CL**

CO-1	Identify/ Explain the operation of various components of the microprocessor 8085 and microprocessor 8086	**PSO-1**	**A**
CO-2	Relate and explain the various addressing modes and the instruction set of 8085 microprocessor	**PSO-1**	**R**
CO-3	Develop skill in writing simple programs for 8085 microprocessor	**PSO-2**	**C**
CO-4	Explain the architecture of 8051 microcontroller	**PSO-1**	**U**
CO-5	Understand the various interrupts of 8085 microprocessor	**PSO-2**	**U**

Modules

Credits:4 **Total contact hours: 90 (Including assignments and tests)**

Unit	Section	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Microprocessors 8085 Architecture**					
	1	Intel 8085 microprocessor : Introduction – Pin configuration- Architecture and its operations	4	To understand the principle of microprocessor, architecture and its operation	Lecture Discussion with PPT illustration	Evaluation through: shorttest Class Test Multiple choice questions Quiz Formative assessment I
	2	Machine cycles of 8085- Interfacing of memory and I/O devices	4	To understand the concept of machine cycles and interfacing	Lecture discussion	
	3	Instruction classification: number of bytes, nature of operations-	4	To know the classification of instructions according to their byte size and its nature of operation	Lecture discussion	
	4	Instruction format- Vectored and non-vectored interrupts	3	To distinguish between vectored and non-vectored interrupts	Lecture discussion	

II	**8085 Assembly Language Programming**					
	1	Instruction set: Data transfer operations - Arithmetic operations	4	To understand the use of data transfer and arithmetic instructions	Lecture Illustration PPT	Evaluation through: Short test Quiz Assignment Formative assessment Class test Open book test
	2	Logical operations- Branching and machine control operations -	4	To categorize the logical, branching and machine control operations and know its use while writing assembly language program	Lecture discussion PPT	
	3	Addressing modes Writing assembly language programs: Looping, counting and indexing	4	To be able to know the different addressing modes to access data	Lecture Illustration PPT	
	4	Stack – subroutine- Translation from assembly language to machine language	3	To understand about stack and subroutine	PPT Descriptive Lecture	
III	**Microprocessor 8086**					
	1	Intel 8086 microprocessor: Introduction – Architecture - Pin configuration	**4**	To understand the architecture and pin configuratio n of 8086	Lecture with PPT Illustration	Evaluation through: Class test Quiz Multiple choice questions Formative assessment II
	2	Operating modes: Minimum mode, Maximum mode.	3	To understand the different operating modes of 8086	Question-answer session Lecture	

	3	Memory addressing: 8-bit data from even and odd address bank, 16-bit data from even and odd address bank- Addressing modes	4	To acquire knowledge on memory addressing and addressing modes	Lecture with PPT Illustration	
	4	Interrupts: Hardware interrupts – Software interrupts –Interrupt priorities- Simple programs.	4	To understand the concept of interrupts and difference between hardware and software interrupts	Lecture PPT	
IV	**Microcontroller 8051 Architecture and Programming**					
	1	Introduction to microcontroller and embedded system- Difference between microprocessor and microcontroller	3	To acquire knowledge on microcontroller and the difference between microprocessor or microcontroller	Lecture Discussion PPT	Evaluation through: Class test Quiz Short test Formative assessment II
	2	8051 microcontroller: Pin configuration, Architecture and Key features. 8051 Data types and directives	4	To understand the pin configuration, architecture	Lecture Discussion PPT	

	3	Instruction set: Data transfer instructions - Arithmetic instructions – Logical instructions-	4	To be able to understand the data transfer, arithmetic and logical instructions to write assembly language program		
	4	Branching instructions- Single bit instructions. Addressing modes- Simple programs using 8051 instruction set.	4	To know the addressing modes of 8051 and simple programmes using instruction set		

	Interfacing of Microprocessor 8085					
	1	Basic concepts of programmable device - 8255 Programmable Peripheral Interface (PPI)	5	To have practical knowledge on angle of friction and cone of friction	Lecture with PPT	Evaluation through: Short test Class test Open book test Quiz Assignment Formative assessment III
	2	interface of ADC and DAC-8257 Direct Memory Access (DMA) controller	5	To understand the concept rectangular and triangular lamina.	Lecture Illustration	
	3	Basic concepts of serial I/O and data communication – interface of 8251 Universal Synchronous Asynchronous Receiver Transmitter (USART)	5	To be able to understand the basic concepts of serial input and output and data communicatio n	Lecture with PPT Illustrat ion	

Semester IV
Course Name: Nuclear and Elementary Particle Physics
Course Code: PP2041

Hours/Week	Credits	Total Hours	Marks
6	**5**	**90**	**100**

Learning Objectives

1. To know about the fundamental principles and concepts governing nuclear and particle physics and their social, economic and environmental implications.
2. To understand the concept of elementary particles.

Course Outcome

COs	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	Understand the properties of Nuclear forces and outline their behavioral formulation.	**PSO - 1**	**U**
CO-2	Analyze the different nuclear models of the nucleus and examine the application of the shell model of nucleus.	**PSO - 4**	**E**
CO-3	Explain the characteristics and effect of radioactive decay phenomena. (alpha,beta,gamma)	**PSO - 1**	**U**
CO-4	Discuss the outcome of various types of nuclear reactions.	**PSO - 4**	**C**
CO-5	Examine the Particle Physics phenomena and their basic theoretical description.	**PSO - 3**	**An**

Module
Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Section	Topics	Lecture Hours	Learning outcomes	Pedagogy	Assessment/Evaluation
I	**Nuclear Forces**					
	1	Characteristics of Nuclear Forces – Exchange forces and tensor forces – charge independence	**4**	Define the basis of Nuclear Forces	PPT, Illustration and theoretical derivation	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Open book assignment Formative assessment I
	2	Spin dependence of Nuclear Forces - Meson theory	**4**	Apply Meson theory of nuclear	Derivation and group discussion	

		of nuclear forces- Ground state of deuteron		forces		
	3	Nucleon-nucleon scattering singlet and triplet parameters – Nucleon-Nucleon scattering: Cross-section, Differential Cross-section, Scattering Cross-sections	**4**	Derivation of Nucleon-Nucleon scattering	PPT, Illustration, Theoretical formulation	
	4	Magnetic moment-Quadrupole moment –S and D state admixtures - Effective range theory of n-p scattering at low energies.	**3**	Apply Quadrupole moment –S and D state admixtures	Derivation and group discussion	
II	**Nuclear Models**					
	1	Binding energy & mass defect – Weizacker's formula – mass parabola	**4**	Solve Weizacker' smass formula	PPT, Derivation discussion	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment I
	2	Liquid drop model - Bohr - Wheeler theory of fission-Activation energy for fission	**4**	Analyse the liquid drop model of nucleus, Define and derive equations	Derivation, group discussion problem solving	
	3	Shell model-Spin –Orbit coupling-Spins of nuclei-Magnetic moments – Schmidt lines-	**3**	Statement and proof of Shell model of nucleus and Electric quadrupole	Illustration, Theoretical formulation	

		Electric quadrupole moments		moments		
	4	Collective model of Bohr and Mottelson: Nuclear vibration – Nuclear rotation –Nelson model	**4**	Examine the Collective model of Bohr and Mottelsona nd its applications	Derivation and group discussion problem solving	
III	**Nuclear Reactions**					
	1	Nuclear reaction - Q- value – Nuclear reaction cross section – Direct Nuclear Reactions	**4**	Explore Nuclear reaction cross section	Derivation, group discussion	Evaluation through: Online quiz, Problem solving Short Questions Descriptive answers Formative assessment I/II
	2	Knock out reaction, Pick-up reaction, Stripping reaction – Compound nucleus theory – Formation – Disintegration energy levels – Partial wave analysis of Nuclear reaction cross-section	**3**	Obtain the Compound nucleus theory	Illustration, Theoretical formulation	
	3	Resonance Scattering and Reaction cross-section (Breit-Wigner dispersion formula) – Scattering matrix	**4**	Derive Breit Wigner dispersion formula	Derivation and group discussion, PPT	
	4	Reciprocity theorem – Breit -Wigner one level formula – Resonance scattering –	**4**	Define, deriveand apply Breit-Wigner one level formula	PPT, Illustration, Theoretical formulation	

		Absorption cross section at high energy.				
IV	**Radioactive Decays**					
	1	Alpha decay - Beta decay – Energy release in beta decay – Fermi theory of beta decay	**4**	Discuss different typesof radioactive decays	Derivation discussion	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	Shape of the beta spectrum – decay rate Fermi-Curie plot – Fermi & G.T Selection rules	**3**	Define and derive principle and logic of Curie plot	Derivation and group discussion, PPT	
	3	Comparatives half - lives and forbidden decays- Gamma decay - Multipole radiation	**4**	Discuss about different types of Gama decay	Derivation and group discussion	
	4	Angular momentum and parity selection rules – Internal conversion – Nuclear isomerism.	**4**	Analyze charge parity selection and scrutinize the Charge Nuclear isomerism	Derivation and group discussion	
V	**Elementary Particle Physics**					
	1	Classification of elementary particles - Types of interaction between elementary particles – Hadrons and leptons	**3**	AnalyzeFundamental Classification of elementary particles	Discussion PPT	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Assignments, Seminars Formative assessment II
	2	Symmetry and conservation laws – Strangeness and associate production - CPT theorem – classification of hadrons	**4**	Analyse the conservation laws and prove CPT theorem	Derivation and group discussion, PPT	

	3	Quark model - Isospin multiples - SU(2)- SU(3) multiplets- Gell-Mann - Okubo mass formula for octet and decouplet hadrons	**4**	Explain and derive mass formula for octet and decouplet	Derivation and group discussion	
	4	Phenomenology of weak interaction hadrons and leptons- Universal Fermi interaction – Elementary concepts of weak interactions.	**4**	Define, deriveand apply Universal Fermi interaction – Elementary concepts of weak interactions	Derivation and group discussion, PPT	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Staff-in charges: Ms.C.Nirmala Louis &Ms. R. Krishna Priya

Semester IV
Course Name: Spectroscopy
Course Code: PP2042

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objectives

1. To gain knowledge about the basic principles of spectroscopy.
2. To gain insight about the spectroscopic instruments and its applications.

Course Outcome

Cos	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	apply basic spectroscopic techniques. (Microwave, IR, Raman and NMR)	**PSO - 4**	**U**
CO - 2	infer basic spectroscopic techniques. (Microwave, IR, Raman, ESR, NQR and NMR)	**PSO - 6**	**Ap**

CO - 3	understand the molecular interactions in different spectroscopic methods.	**PSO - 1**	**An**
CO - 4	analyze the characteristics of rotational spectra and vibrational energy of molecules.	**PSO - 3**	**An**
CO - 5	utilize various spectroscopic methods suitable for characterizing molecules.	**PSO - 6**	**C**

Modules

Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Section	Topics	Lecture Hours	Learning outcomes	Pedagogy	Assessment/Evaluation
I	**Microwave Spectroscopy**					
	1.	Rotation of Molecules – Rigid Rotor (Diatomic Molecules)	**4**	Define the basis of Semiconductor	PPT, Illustration and theoretical derivation	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment I
	2	Expression for the Rotational Constant - Intensity of Spectral Lines	**4**	Derive the expression for the Rotational Constant	Derivation and group discussion,	
	3	Effect of Isotopic Substitution - Molecular Parameters (Bond Length, Bond Angle , Dipole Moment from Rotation Spectra)	**4**	Explain the effect of Isotopic substitution of molecules and derive the Molecular Parameters (Bond Length, Bond Angle from Rotation Spectra)	PPT, Illustration, derivation and group discussion	
	4	Techniques and Instrumentation	**3**	Explain the instrumentation techniques of microwave spectrometer	Derivation and group discussion	
II	**Infrared Spectroscopy**					
	1	Vibrational energy of a diatomic molecule- Infrared selection rules- Vibrating diatomic molecule- IR spectrophotometer	**4**	Derive the vibrational energy of a diatomic molecule	PPT, Derivation discussion	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment I
	2	Diatomic vibrating rotator- Vibrations of polyatomic molecules-Fermi resonance	**4**	Derive equation for diatomic vibrating rotator and vibrations of polyatomic molecules	Derivation and group discussion problem solving	
	3	Rotation vibration spectra of polyatomic molecules-	**3**	Explain the normal modes of vibration in	Illustration, Derivation	

		Normal modes of vibration in crystal Interpretation of vibrational spectra-Group frequencies -		crystal Interpret the vibration spectra and Group frequencies	and group discussion problem solving	
	4	Instrumentation-Sample handling techniques-Fourier Transform Infrared spectroscopy-Applications	**4**	Explain the Instrumentation of IR spectrophotometer Discuss its applications	Derivation and group discussion problem solving	
III	**Raman Spectroscopy**					
	1	Introduction-Theory Of Raman Scattering-Rotational Raman Spectra-Vibrational Raman Spectra-Mutual Exclusion Principle	**4**	Devive the theories of Raman spectrometer	Derivation discussion	Evaluation Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment I/II
	2	Raman Spectrometer-Sample Handling Techniques-Polarization Of Raman Scattered Light-Structure Determination Using IR And Raman Spectroscopy-Raman Investigation Of Phase Transitions	**3**	Explain the Raman Spectrometer and discuss its sample Handling Techniques Discuss the Structure determination Using IR And Raman Spectroscopy	Illustration, Theoretical formulation Derivation and group discussion,PPT	
	3	Resonance Raman Scattering-Nonlinear Raman Phenomena-Preliminaries-Hyper Raman Effect	**4**	Define Nonlinear Raman Phenomena, Preliminaries and Hyper Raman Effect	Derivation and group discussion, PPT	
	4	Stimulated Raman Scattering-Inverse Raman Effect-Coherent Anti-Stokes Raman Scattering.	**4**	Discuss the anti-Stokes lines of Raman Scattering	PPT, Illustration, Theoretical formulation	
IV	**Nuclear Magnetic and Electron Spin Resonance Spectroscopy**					
	1	Basic principles – Quantum theory of NMR - magnetic resonance – relaxation processes	**4**	Explain the basic principles of NMR .relaxation processes	Derivation discussion ,PPT	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	chemical shifts – spin-spin coupling - Spectra and molecular structure – Fourier Transform NMR Instrumentation – Applications	**3**	Define and derive chemical shifts Explain the Instrumentation and Applications of NMR	Derivation and group discussion, PPT	

	3	Basic principles – Quantum theory – g-factor – Nuclear Interaction and Hyperfine structure – Relaxation effects	**4**	Explain the Nuclear Interaction and Hyperfine structure	Derivation and group discussion	
	4	Hyperfine interaction – line widths – ESR spectrometer – Instrumentation – applications	**4**	Discuss the ESR spectrometer, Instrumentation and its applications	Derivation and group discussion	
V	**Nuclear Quadrupole Resonance and Mossbauer Spectroscopy**					
	1	Basic theory - Nuclear Electric quadrupole interaction – Energy levels – Transition frequency – Excitation and Detection	**3**	Discuss the nuclear electric quadrupole interaction	Discussion PPT	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	Effect of magnetic field - Instrumentation – Applications. Mossbauer effect - recoilless emission and absorption	**4**	Discuss the effect of magnetic Field and its instrumentation	Derivation and group discussion, PPT	
	3	hyperfine interaction - chemical isomer shift - magnetic hyperfine and electric quadruple interactions	**4**	Explain the magnetic hyperfine and electric quadruple interactions	Derivation and group discussion PPT	
	4	Instrumentation applications.	**4**	Explain the instrumentation and its application	Derivation and group discussion, PPT	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Staff-in charge: Ms.V.Shally & Ms.Jenepha Mary

Semester IV

Course Name: Thermodynamics and Statistical Mechanics

Course code: PP2043

No.of hours per week	No. of credits	Total No. of hours	Marks
6	5	90	100

Learning Objectives

1. To provide a phenomenological introduction to thermodynamics throughthermodynamics postulates, quantities and relations.
2. To understand the micro and macroscopic properties of the matter through the statistical probability laws and distribution of particles and study the transport properties, different phases of maters, equilibrium and nonequilibrium process.

Course Outcomes

Cos	Upon completion of this course, students will be able to:	PSO addressed	CL
CO - 1	understand the basic concepts related to thermodynamics, microstates and macrostates	**PSO - 4**	**U**
CO - 2	apply principles to find relation between grand canonical and canonical partition functions	**PSO - 1**	**Ap**
CO - 3	solve the Bose-Einstein, Fermi-Dirac and Maxwell-Boltzmann distributions	**PSO - 4**	**C**
CO - 4	analyze the origin of transport and non-equilibrium processes	**PSO - 3**	**An**
CO - 5	understand the concept of heat capacities and phase transitions	**PSO -4**	**U**

Teaching Plan

Credits: 5 **Total Hours: 90 (Incl. Seminar &Test)**

Unit	Module	Topics	Lecture hours	Learning outcome	Pedagogy	Assessment/ Evaluation
I	**Thermodynamics, Microstates and Macrostates**					

	1	Basic postulates of thermodynamics – Phase space and ensembles – Fundamental relations anddefinition of intensive variables – Intensive variables in the entropic formulation	4	Understand the concepts of thermodynamics	PPT, Descriptive lecture	Evaluation through: quiz, Problem solving Descriptive answers short questions Formative assessment (I CIA)
	2	Equations ofstate – Euler relation, densities - Gibbs-Duhem relation for entropy - Thermodynamic potentials–Maxwell relations – Thermodynamic relations	4	To study the different relations and equations of thermodynamics	Illustration, Descriptive lecture	
	3	Microstates and macrostates – Ideal gas –Microstate and macrostate in classical systems – Microstate and macrostate in quantum systems–	4	Understand the basic concept of thermodynamical states	Illustration, Descriptive lecture	
	4	Density of states and volume occupied by a quantum state	3	To study DOS of systems	Illustration, Descriptive lecture	
II	**Microcanonical, Canonical and Grand CanonicalEnsembles**					
	1	Microcanonical distribution function – Two level system in microcanonical ensemble – Gibbsparadox and correct formula for entropy	4	Understand the concept of ensembles	PPT Illustration, Descriptive	Evaluation through: quiz,

					lecture	
	2	The canonical distribution function – Contact with thermodynamics	3	To acquire knowledge on distribution function of thermodynamics	Lecture, Seminar	short questions Descriptive answers Problem solving Formative assessment (I&II CIA)
	3	Partition function and free energy of an ideal gas - the grand partition function	4	To understand the concepts of partition function	Descriptive lecture	
	4	Relation between grand canonical and canonical partition functions – One-orbitalpartition function	4	Understand the relation between partition functions	Descriptive lecture, seminar	
III	**Bose-Einstein, Fermi-Dirac and Maxwell-BoltzmannDistributions**					
	1	Bose-Einstein and Fermi-Dirac distributions –Chemical potential of bosons –Number density of photons and Bose condensation	4	To learn about Bose-Einstein distribution and bosons	Illustration, Descriptive lecture	Evaluation through: quiz, short questions Descriptive answers Formative assessment (I CIA)
	2	Thermodynamic quantities – Non-interactingBose gas and thermodynamic relations - The principle ofdetailed balance	3	To understand the basic thermodynamic quantities	Lecture, Seminar	
	3	Thermodynamic relationsfor non-interacting Fermi gas – Fermi gas at zero and low temperature – Fermi energy and Fermimomentum	4	To know the relations concerned with fermi gas	Descriptive lecture	
	4	Maxwell-Boltzmann distribution law for microstates in a classical gas – Physical interpretation of the classical limit – Fluctuations in different ensembles	4	To gain knowledge on Maxwell-Boltzmann distribution and classical interpretation	Group Discussion, Lecture, seminar	
IV	**Transport and Non-Equilibrium Processes**					
	1	Derivation of Boltzmann transport equation for change of states without and with collisions –Boltzmann equation for quantum statistics – Equilibrium distribution in Boltzmann equation	5	To have a clear idea on Boltzmann equations	PPT Illustration, Descriptive lecture.	Evaluation through quiz,Descriptive answers

	2	Transport processes; One speed and one dimension - All speeds and all directions – Conservedproperties - Distribution of molecular velocities – Equipartition and Virial theorems	5	To understand transport, speed, velocity and properties	Lecture, Group discussion	short questions
	3	Randomwalk - Brownian motion - Non-equilibrium process; Joule-Thompson process - Free expansionand mixing - Thermal conduction - The heat equation.	5	To study the concept of expansion and conduction	Lecture, seminar	Assignment, Formative assessment (II CIA)
V	**Heat Capacities, Ising Model and Phase Transitions**					
	1	Heat capacities of heteronuclear diatomic gas – Heat capacities of homonuclear diatomic gas –Heat capacity of Bose gas	4	To acquire knowledge on heat capacity of gases	PPT Illustration, Descriptive lecture	Evaluation through: quiz, short questions
	2	One-dimensional Ising model and its solution by variational method– Exact solution for one-dimensional Ising model	4	To get a brief idea on Ising model	Descriptive lecture	Descriptive answers
	3	Phase transitions and criterion for phasetransitions – Classification of phase transitions by order and by symmetry	4	To learn about phase transitions and its classifications	Descriptive lecture, Seminar, Assignment	Problem solving
	4	Phase diagrams forpure systems – Clausius-Clapeyron equation – Gibbs phase rule	3	To study the phase diagrams and phase rules	Illustration, Descriptive lecture	Formative assessment (II CIA)

PO- Program outcome; LO – Learning outcome; Cognitive Level U – Understand; Ap- Apply, An- Analyze; K- Knowledge

Course Instructor : Dr. M. Priyadharshini and Ms. P. AjiUdhaya

Semester IV
Course name: Advanced Nano Physics
Course code: PP2045

Hours/Week	Credits	Total Hours	Marks
6	5	90	100

Learning Objectives

1. To understand the theoretical aspects of low dimensional semiconductor systems.
2. To learn the structures, properties, characterization and applications of nanomaterials.

Course Outcome

COs	Upon completion of this course the students will be able to:	PSO addressed	CL
CO- 1	Identify how basic physics can be used to describe the behaviour of electrons in nano-scale materials.	**PSO-1**	**R**
CO- 2	Explain the variation in the electron distribution in nanostructures for different dimensions (Quantum well, Quantum wires & quantum dots)	**PSO-3**	**U**
CO- 3	Analyze magneto electronics and applications of Nanotechnology in various fields.	**PSO-6**	**An**
CO -4	Explain Laser effect in Quantum well, Quantum wires and quantum dots .	**PSO-2**	**U**
CO- 5	Compare the structure and properties of Carbon nanostructures and their applications in the emerging nanotechnology	**PSO-6**	**E**
CO -6	Discuss the fabrication and characterization techniques of nanomaterials	**PSO-2**	**U**
CO -7	Develop key concepts in Single electron transistor, Spintronics and Giant magnetoresistance	**PSO-4**	**C**

Modules

Total contact hours: 90 (Including lectures, assignment and tests)

Unit	Section	Topics	Lecture Hours	Learning outcomes	Pedagogy	Assessment/Evaluation
I	**Introduction to Nano and Types of Nanomaterials:**					
	1	Need and origin of nano, Nano and energetic-Top-down and bottom-up approaches	4	To understand the importance of nano	Lecture Discussion with PPT Illustration	
	2	Introductory ideas of 1D, 2D and 3D nanostructured materials	4	be able to distinguish between 1D, 2D and	Lecture discussion	Evaluation through: Online quiz,

				3D nanomaterials		Formative assessment I
	3	Quantum well: Quantum well infrared detector- quantum well laser- quantum cascade laser- Quantum wire: Production- VLS growth mechanism- structure and uses-	4	understand the concept quantum well and its applications	PPT Illustration	
	4	Quantum dots: Description- Exciton confinement in quantum dots – Epitaxially self-assembled quantum-dot- Application: Quantum dot laser	3	To learn about the synthesis and applications of quantum dots	Lecture discussion	
II	**Carbon Nanostructures**					
	1	Carbon molecules and carbon bond - C60: Discovery and structure of C60 and its crystal -Superconductivity in C60 -Fullerene	4	To understand the significance of C60 in nanotechnology	PPT and group Discussion	Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment I
	2	Carbon Nano Tubes (CNT): Types- Fabrication: Electric Arc-discharge method- Laser method	4	To be able to synthesize carbon nanotubes	Lecture Discussion with PPT Illustration	
	3	Solar production of carbon nanotubes - Chemical vapour deposition– Electronic structure – Electrical properties	3	To understand the different synthesis methods in CNT production	PPT Illustration	
	4	Vibrational properties – Mechanical	4	To learn the different applications	Lecture Discussion with	

		properties – Applications (fuel cells, chemical sensors, catalysts) – Filling of carbon nanotubes - CNT emitters		of carbon nanotubes	PPT Illustration	
III	**Fabrication of Nanomaterials**					
	1	Synthesis of oxide nanoparticles by sol-gel method - Synthesis of metallic nanoparticles Electrochemical deposition method	4	To be able to differentiate the synthesis methods in nanomaterial preparation	Lecture discussion	Evaluation Evaluation through: Online quiz, Short questions Descriptive answers Formative assessment I/II
	2	Sonochemical reduction method – Lithography -- Atomic layer deposition - Synthesis of semiconductor nanoparticles	3	To be able to synthesize semocond uctor nanoparti cles	Lecture Discussion with PPT Illustration	
	3	Arrested precipitation method- Core shell structures – Bio synthesis of nanoparticles using plants	4	To understand the techniques in bio synthesis of nanoparti cles	Lecture discussion	
	4	Preparation of magnetic nanomaterials - Super paramagnetism - Coulomb blockade – Single electron transistor	4	To understand the preparation and applications of magnetic nanomaterials	PPT and group Discussion	
IV	**Characterization of Nanomaterials**					

	1	Principles, experimental set-up, procedure and utility of X-ray diffraction (XRD), Scanning electron microscopy (SEM)	4	To understand the principles, experimental set-up, procedure and utility XRD and SEM	Lecture Discussion with PPT Illustration	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	Atomic force microscopy (AFM), Scanning tunneling microscope (STM) and scanning probe microscopy (SPM), Fourier transform infrared spectroscopy	3	To be able to interpret the structural properties using AFM, STM, SPM and FTIR	Lecture discussion	
	3	Quantum cellular Automata-Spintronics - Giant magnetoresistance	4	To understand the concept giant magnetoresistance	PPT Illustration	
	4	Quantum Hall effect - Quantum spin Hall effect - Fractional quantum Hall effect	4	To understand the concept Quantum Hall effect	Lecture Discussion with PPT Illustration	
V	**Applications**					
	1	Molecular electronics and nanoelectronics - Nanorobots - Biological applications of nanoparticles	3	To understand the importance of nanoelectronics	PPT Illustration	Evaluation through: Online quiz, Problem solving short questions Descriptive answers Formative assessment II
	2	Catalysis by gold	4	To be able	Lecture	

		nanoparticles – Band-gap engineered quantum devices -Nanomechanics		to mention the importance of nanomechanics	Discussion with PPT Illustration	
	3	Photo electro chemical cells – Photonic crystals – Plasmon waveguides. Sensors – MEMS/NEMS – Solar cells – Displays	4	To learn the applications of nanoparticles in NEMS	Lecture discussion	
	4	Optical switches – Graphene electronics – Biosensors – Biomarkers and Bio imaging – Targeted drug delivery	4	To learn the applications of nanoparticles in medical field	PPT Illustration	

PO- Program outcome; LO – Learning outcome; Cognitive Level R – Remember; U – Understand; Ap- Apply, An- Analyze; E-Evaluate; C- Create

Staff-in charge: Ms. A. Lesly Fathima & Sr. S. Sebastiammal

Head of the Department: Dr. C. Nirmala Louis