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 IV

Elective IV (a) : Nano Physics

Subject code: PP1744

Teaching Plan

Unit	Modules	Topics	Lecture Hours	Learning outcomes	Pedagogy	Assessment/valuation
I	**Nanomaterials Synthesis and Characterization**					
	1	Nano structures – Synthesis of	**4**	Identify Nano structures &	Lecture discussion	Evaluation

		nanoparticles : Sol-gel processing – Arrested precipitaiton – Biosynthesis of nanomaterials using plants		Biosynthesis of nanomaterials using plants		Class test, oral question Assignment I
	2	Carbon nanotubes - Electronic structure of carbon nanotubes - Types of carbon nanotubes	**3**	Apply various Electronic structure of carbon nanotubes	Derivation and group discussion	
	3	Synthesis of carbon nanotubes: Laser method- CVD (Pyrolysis of Hydrocarbons) – CVD method on flat surfaces - Solar production of carbon nanotubes – Properties - Applications	**4**	Discuss various methods of synthesis of carbon nanotubes	Derivation, and group discussion	
	4	Fullerene – Properties of Fullerene. Structural characterisation: XRD – Scanning Tunnelling Microscope (STM) – Atomic Force Microscope (AFM) – Properties of nanomaterials. Structural characterisation: XRD – FTIR	**4**	Apply Fullerene. Structural characterisation	Derivation and group discussion seminar	
II	Quantum hetrostructures					
	1	Novel phenomena - Heterostructure – Growth of heterostructure – Molecular Beam Epitaxy	**4**	Explain the in nanostructures for different dimensions	Derivation discussion	Evaluation Class test, oral question Assignment I/II
	2	Band alignment – Quantum well – Superlattice - Doped Heterostructures – Quantum wells in heterostructures	**3**	Define and derive Superlattice & Doped Heterostructures	Derivation and group discussion seminar	
	3	Effective mass theory	**4**	Statement and	Derivation	

		in heterostructures – Application of effective mass theory in quantum wells in heterostructures		proof of Effective mass theory	and group discussion problem solving	
	4	Applications of heterostructures.	**4**	Heterostructures and its applications	Derivation and group discussion	
III	**Quantum well, quantum wires & quantum dots**					
	1	Preparation of Quantum nanostructures - Size effects - Fermi gas and density of states - Calculation of the density of states	**4**	Analyse Quantum nanostructures	Derivation discussion	Evaluation Class test, oral question Assignment II
	2	Quantum wire – Production, structure and uses – Quantum dot : production	**2**	Define and derive Production, structure and uses of Quantum nanostructures	Derivation and group discussion seminar	
	3	Epitaxially self assembled quantum dots – Electronic energy states – Application	**5**	Define and Derive Electronic energy states	Derivation and group discussion,PPT	
	4	Quantum well infrared detector – Quantum well and quantum cascade laser – Quantum dot laser.	**4**	Define, derive and apply Quantum well and quantum cascade laser &Quantum dot laser.	Lecture and group discussion PPT	
IV	**Magneto electronics and applications of nanotechnology**					
	1	Nano crystalline soft magnetic materials – Permanent magnet materials – Preparation of magnetic nanomaterials	**4**	Discuss different types of Nano crystalline soft magnetic materials	Derivation discussion	Evaluation Class test, oral question Assignment II/III
	2	Super paramagnetism - Coulomb blockade – Single electron	**4**	Define and derive Coulomb blockade and its	Derivation and group discussion,	

		transistor - Spintronics		applications	PPT	
	3	Giant magnetoresistance - Quantum Hall effect - Quantum spin Hall effect	**3**	Define and Derive different types of Giant magnetoresistance	Derivation and group discussion seminar	
	4	Fractional quantum Hall effect - Applications of nanotechnology.	**4**	Applications of nanotechnology	Lecture and group discussion PPT	
V	**Applications of Nanomaterials**					
	1	Nanoelectronics – Introduction – Sensors – MEMS/NEMS	**4**	Analyse Fundamental Nano Sensors	Discussion PPT	Evaluation Class test, oral question Assignment **III**
	2	Solar cells – Displays – Optical switches	**4**	Analyse classification Solar cells	group discussion, PPT	
	3	Graphene electronics – Biosensors – Biomarkers and Bioimaging	**3**	Explain Graphene electronics	Derivation and group discussion seminar	
	4	Targeted drug delivery – Nanorobots.	**4**	Define , derive and apply Nanorobots	Derivation and group discussion, PPT	

Course instructor: Dr. C. Nirmala Louis **Head of the Department:** Dr. S. Mary Delphine

Semester IV
Material Science
Subject Code: PP1741

Teaching Plan

Unit	Modules	Topics	Lecture hours	Learning outcome	Pedagogy	Assesment/Evaluation
I	**Phase diagram**					
	1	Phase rule- Single component systems	2	To understand basic concepts of phases of materials.	Illustration and theoretical explanation	Evaluation through: quiz, Problem solving short questions
	2	Binary Phase diagrams- Microstructural Changes during Cooling	2	To understand the microstructural changes of materials.	Illustration, Theoretical explanation	
	3	The lever rule- Applications of phase diagrams- Phase transformations- Time scale for phase changes	4	To analyze phase transformations.	Analysis and Theoretical explanation	

	4	The growth and the overall transformation kinetics of nucleation– Applications	4	To understand the process of nucleation.	Theoretical explanation and Problem solving	Descriptive answers Formative assessment
II	**Elastic Behaviour**					
	1	Atomic model of elastic behavior	3	To understand the basic concepts of elastic behavior.	PPT Illustration, Lecture.	Evaluation through: quiz, short questions Descriptive answers Problem solving Formative assessment
	2	The modulus as a parameter in Design	3	To understand the importance of elasticity in designing structures.	Descriptive lecture, comparative study.	
	3	Rubber-like elasticity-Anelastic behavior:	3	To understand anelastic behavior.	Theoretical explanation	
	4	Relaxation Processes- Viscoelastic behavior: Spring-Dashpot models	3	To analyze relaxation processes in materials.	Illustration, Theoretical explanation	
III	**Imperfections**					
	1	Crystal imperfections- Point imperfections	4	To interpret crystal imperfections.	Illustration, Theoretical explanation	Evaluation through: quiz, short questions Descriptive answers Assignment on applications Formative assessment
	2	The geometry of dislocations- other properties of dislocations	4	To understand properties of dislocations	Illustration, Theoretical explanation	
	3	surface imperfections	4	To analyze surface imperfections	Illustration, Theoretical explanation, comparative study	
IV	**Oxidation, Corrosion and other deformation of materials**					
	1	Mechanisms of oxidation-oxidation	1	To understand the basic concepts and	PPT Illustration,	Evaluation through: quiz,

		resistant materials		features of oxidation resistant materials.	And Descriptive lecture	short questions Descriptive answers Assignment on applications. Formative assessment
	2	the principles of corrosion-protection against corrosion	3	To understand the concept of corrosion.	Descriptive lecture, Theoretical explanation	
	3	plastic deformation- the tensile stress- stress-strain curve- plastic deformation by slip creep	4	To apply deformation theory to analyze the tensile stress and plastic deformation.	Descriptive lecture and Theoretical explanation	
	4	mechanisms of creep-creep resistant materials- Ductile fracture- Brittle fracture- Methods of protection against fracture.	4	To understand methods of protection against fracture	Descriptive lecture and Theoretical explanation	

Course instructor: Ms. M. Abila Jeba Queen **Head of the Department:** Dr. S. Mary Delphine

Semester IV
Molecular Spectroscopy
Subject Code: PP1743
Teaching Plan

Unit	**Modules**	**Topics**	**Lecture hours**	**Learning outcome**	**Pedagogy**	**Assessment/ Evaluation**
I	**Microwave spectroscopy**					
	1	Classification of molecules - Interaction of radiation with rotating molecule	**3**	To understand the classification of molecules and their interactions.	Lecture Discussion with PPT illustration	Evaluation through short test Multiple choice questions Assignment Seminar Formative assessment I
	2	Rotational spectra of rigid diatomic molecules – Isotope effects in rotational spectra – Intensity of rotational lines	**4**	To acquire knowledge on the rotational spectra of rigid diatomic molecules	Lecture videos PPT	
	3	Non-rigid rotator – Vibrational excitation effects – Symmetric top molecules	**3**	To know the principles of Non-rigid rotator and Symmetric top molecules	Lecture discussion	
	4	Microwave spectrometer –	**3**	To identify the	PPT	

		Information derived from rotational spectra.		principles and working of microwave spectrometer	Illustration, Descriptive lecture	
II	**Infrared spectroscopy**					
	1	Vibrational energy of a diatomic molecule – Infrared spectra – Infrared selection rules	**4**	To understand infrared spectra and acquire knowledge on selection rules	Lecture Illustration videos PPT	Short test Quiz Assignment Formative assessment I
	2	Vibrating diatomic molecule – Diatomic vibrating rotator – Asymmetry of rotation	**4**	To acquire knowledge on diatomic vibrating rotator and asymmetry of rotation.	Lecture discussion videos PPT	
	3	Vibration band – Vibrations of polyatomic molecules – Rotation vibration spectra of polyatomic molecules	**4**	To derive equations for rotation-vibration spectra of polyatomic molecules.	Lecture discussion videos PPT	
	4	IR spectrophotometer – Instrumentation - Sample handling techniques – Fourier transform infrared spectroscopy – Applications (any two)	**2**	To understand the working of IR spectrophotometer and discuss its applications.	Lecture Illustration videos PPT	
III	**Raman spectroscopy**					
	1	Theory of Raman scattering – Rotational Raman spectra	**5**	To acquire knowledge on Raman scattering	Lecture with PPT Illustration	Assignment Seminar Formative assessment

	2	Vibrational Raman spectra – Mutual exclusion principle	**3**	To understand the concept of vibrational Raman spectra and Mutual exclusion principle	Question-answer session Lecture	II
	3	Raman spectrometer – Polarization of Raman scattered light - Structure determination using IR and Raman spectroscopy.	**5**	To understand the working of Raman spectrometer and differentiate IR and Raman spectroscopy.	Lecture with PPT Illustration	
IV	**Electronic spectroscopy**					
	1	Introduction – Vibrational coarse structure – Vibrational analysis of band systems	**3**	To understand the concept of vibrational analysis of band systems	Lecture Discussion videos ppt	Formative assessment II
	2	Progressions and sequences – Information derived from vibrational analysis	**3**	To distinguish progressions and sequences	Lecture Discussion videos	
	3	Frank – Condon principle – Intensity of vibrational electronic spectra	**4**	To have a knowledge on Frank Condon principle and intensity of vibrational spectra.	Lecture with PPT Illustration	

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