

Manohar Memorial PG College, Fatehabad
Lesson Plan Session 2023-24 Even Semester (PG)

Department Physics M.Sc Final

Paper : Material Science -II

Paper : Statistical physics

Paper : laser and spectroscopy II

Paper : Radiation physics

January 2024

Week 1	Free electron theory (qualitative idea) and its features, Idea of band structure, Metals, insulators and semiconductors, Density of state in bands	review of thermodynamics concept/laws required for statistical mechanics, thermodynamics potentials	important process and laser rate equation, amplification in an inhomogeneously broadened system, spatial and spectral hole burning	Origin and energy spectra, Brief discussion of interaction of gamma rays	
Week 2	Variation of density of states with energy. Variation of density of state and band gap with size of crystal	chemical potential, macroscopic and microscopic states, postulate of equal a priori probability, contact b/w statistics and thermodynamics	multi mode oscillation, efficiency of laser and it's various factors	electron and heavy charged particles with matter, different types of Neutron sources	
Week 3	Quantum size effect, electron confinement in infinite deep square well and electron confined in 2 & 3 dimension well	equipartition theorem , entropy of mixing Gibbs paradox, sackur tetraode equation	rate equation for three and four level laser system, variation of laser power around threshold	interaction of Neutron with matter, Neutron detectors	
Week 4	Revision test of unit 1st	phase space, liouville's theorem, concept of ensemble, ensemble average	optimum output coupling, pumping and various laser system: optical and electrical pumping	revision unit test 1st unit	

February 2024

Week 1	Idea of quantum well structure, Quantum wires and dots. Determination of particle size, Increase in width of XRD	microcanonical, canonical, grandcanonical ensemble and partition function	conversion efficiency and excitation mechanisms, structure and important application of laser system: helium neon	Gas filled detectors : Ionization chamber , proportional counter,	
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Week 2	Increase in width of XRD peaks of nano-particles, Shift in photoluminescence peaks, Variation in Raman spectra of nano materials	thermodynamics of classical ideal gas in microcanonical, canonical, grandcanonical ensemble, energy and density fluctuations	Ruby laser, NDYAG, dye laser, CO2 laser	GM counter, scintillation detector, semiconductor detector for X-rays and charged particle detection	
Week 3	Carbon Nanotubes: Synthesis, Structure, Properties and Applications.	revision test of unit 1st and 2nd	argon ion laser, double heterostructure semiconductor, semiconductor quantum well	Radiation exposure, Biological effects of radiation, radiation monitoring	
Week 4	Different methods of preparation of Nanostructured materials: Brief idea of some important physical and chemical techniques	Density matrix, statistics of indistinguishable particles, Maxwell boltzmann, Bose Einstein statistics and Fermi statistics	short and ultra short laser plus generation: index ellipsoid pocal and ker effect, pocal effect in KPD crystal	analysis of nuclear spectrometric data, measurement of nuclear energy levels	

March 2024

Week 1	Study of different techniques like Ball milling. Pulsed laser deposition, Ion beam deposition	statistics of occupation numbers, thermodynamics behaviour of ideal Bose and Fermi gases, Bose Einstein condensation	longitudinal and elementary idea of its transverse configuration Magneto optic and acoustic optic effect, theory of Q-switch laser	spins, parties, moments, internal conversion coefficients, angular correction, perturbed angular correlation	
Week 2	Ion beam deposition, Chemical vapour deposition, Sol-gel, Co-precipitation, Electro-chemical deposition.	laser cooling of atom as an example of Bose condensate, black body radiation and planck's black body radiation formula	theory of mode locking, active and passive, method for q-switching,	measurement of g-factor and hyperfine fields, Safety aspects: radiation dose unit	

Week 3	Different methods of characterization of Nanostructured materials: X-ray diffraction (XRD), Scanning electron microscopy (SEM).	first and second order phase transition	mode locking via passive and active methods in particular electro optic effect	safety limits, Dose calculations , design considerations of simple Shields	
Week 4	Holi Vacations				
April 2024					
Week 1	Characterization of Nanostructured materials: Transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), Raman spectroscop.	critical exponents, Landau theory of phase transition, diamagnetism	non linear optic and laser spectroscopy, introduction to Maxwell equation in non linear optical medium, second harmonic generation,	dosimetric units, radiation dosimetric, radioactive isotopes,gamma camera	
Week 2	UV-visible spectroscopy. Photoluminescence (PL)	paramagnetism and ferromagnetism,Ising model, thermodynamics fluctuations	principal design construction and application: laser Raman spectroscopy,high sensitivity method absorbance spectroscopy frequency	positron emission tomography, introductory idea of single photon emission computed tomography	
Week 3	Revision test of unit 1st & 2nd	random walk and brownian motion,langevin's theory of brownian motion	flourecence excitation spectroscopy	MRI, boron neutron capture therapy,ion beam in cancer therapy	
Week 4	Revision test of unit 3rd & 4th	revision unit test 3rd and 4th	laser induced flourecence	diagnostic nuclear medicine, Therapeutic nuclear medicine	

Date: 11-01-2024

Head : TANYA MEHTA

Manohar Memorial PG College, Fatehabad

Even Semester (PG)

Department of physics

Paper	Quantum mechanics -2	atomic and molecular physics	Solid State Physics	Classical Electrodynamics
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January 2024

Week 1	wkb solutions ,time dependent perturbation theory	Quantum state of 1e- in an atom , electron probability density, space quantization, electron spin	Crystalline solids, Unit cell, Direct lattice, Two and three dimensional Bravais lattices,	Electrostatics in Vacuum: Coulomb's Law, Gauss's Law, Scalar potential, conductors and their properties. Electric field inside a cavity carved in a conductor
Week 2	Fermi golden rule,semi classical theory of radiation	Stern gerlach experiment, spectroscopy term and selection rule, spin orbit interaction energy, quantum mechanics relativity correction	Miller indices, Close packed structures, Reciprocal lattice and its application to diffraction technique	Laplace and Poisson's equations. Electrostatic potentials, Multipole Expansion: Multipole expansion of the scalar potential of a charge distribution. Dipole moment, quadrupole moment.
Week 3	Transition probabilities for absorption and induced and for constant harmonic	hydrogen fine structure, hyperfine structure,,Pauli exculsion principal, exchange of symmetry wave function	Brillouin zones, Diffraction of waves by crystals: X-ray diffraction, Laue,	Electrostatics of Dielectrics: Dielectrics, Induced dipoles, atomic polarizability, Polarization, Bound charges, Clasusius-Mossetti relations, Energy of charges in dielectic
Week 4	basic concepts of scattering cross section, amplitude , laboratory and centre of mass system	LS coupling and jj coupling for equivalent and non equivalent, helium atom and it's spectra (ortho modification and para modification	Powder and Rotating crystal methods, Scattered wave amplitude, Crystal structure factor.	media. Boundary value Problems: Uniqueness theorem, Method of images with examples. Boundary conditions for electric field.

February 2024

Week 1	cross section,born approximation, validity of born approximation and it's application	zeema effect,stark effect and paschen back effect characteristics of xray spectra (kossel experiment and mossely law)	Quantization of elastic waves, Phonon momentum, Dispersion relation for the Vibrations of one dimensional monoatomic and diatomic lattices	Magnetostatics: currents and equation of continuity, Biot-Savart's law, Ampere's law, Differential equations of magnetostatics,
Week 2	shift relation of phase shift with potential, scattered by perfectly rigid sphere and spherical sphere	rivision test unit 1 and 2 (atomic)	Acoustical and optical phonon modes, Inelastic scattering of neutrons by phonons,	Vector potential, Magnetostatic energy. Ohm's law. Boundary conditions for magnetic field at the interface.
Week 3	rivision test of unit 1 &2	types of molecules - diatomic linear and symmetric top and assymmetric top and spherical top	Lattice specific heat (Einstein & Debye model), Free electron Fermi gas, Energy levels	Time Varying Fields and Maxwell Equations: Faraday's law of induction, Displacement current
Week 4	symmetric and antisymmetric, construction of symmetric wave function from unsymmetric wave function	molecules as rigid rotator,non rigid rotator harmonic And anharmonic	density of orbitals in one dimension, Free electron gas in three dimensions.	Maxwell equations, Energy and energy density of the electromagnetic field.

March 2024				
Week 1	Construction of antisymmetric wave function from unsymmetric wave function, distinguishability of identical particles, Pauli	vibrating rotator (energy's level and information spectra) isotropic effect and vibrational rotational spectra	Fermi-Dirac distribution, Electronic specific heat of a metal, Electrons in a periodic lattice (Crystal Potential),	Electrodynamics: Scalar and vector potentials, Gauge transformations, Lorentz and Coulomb gauges, Conservation of energy, Poynting's theorem
Week 2	collision of identical particles, Pauli spin operator, commutation relation, spin, statistics connection, spin matrices, and eigen function	intensity rotational spectra, Raman spectra of diatomic molecules, resolution of eigen function	Bloch theorem, Crystal potential, Kronig-Penny model, Nearly free electron model, Cyclotron resonance,	m, Conservation of momentum. EM waves in various unbounded media: Wave equation, plane waves in free space and isotropic dielectrics
Week 3	electron spin function, the helium atom (para and ortho helium)	born Oppenheimer approximation	Hall effect, Fermi surface, de Haas-Van Alphen effect, Magneto-resistance, Quantum Hall effect.	polarization, energy transmitted by a plane wave, Waves in conducting media, skin depth, EM waves in rarefied plasma and their propagation in ionosphere.
Week 4	Holi Vacations			
April 2024				
Week 1	Klein Gordon equation (free particle), electromagnetic potential, probability and current density, difficulties of KG equation	classification of electronic state, vibrational spectra of electronic transition	Superconductivity: Meissner effect, Critical field, Critical temperature, London equations,	EM Waves in Various Bounded Media-Applications: Reflection and refraction of EM waves at plane dielectrics interface, Fresnel's amplitude relations. Reflection and transmission coefficients.
Week 2	the Dirac relativistic equation matrix for alpha and beta, free particle solution, probability and current density, EM potential	rotational fine structure, P Q R branches of a band, the Fortrat parabola	London penetration depth, Coherence length, Energy gap, Isotope effect,	s. Polarization by reflection. Brewster's angle, Total internal reflection, Wave guide: Derivation of field equations between parallel plates and propagation parameters,
Week 3	existence of spin angular momentum, spin orbit energy, negative energy	intensity of electronic band, Frank-Condon principle, isotropic effect on electron state	BCS theory, Type I & II superconductors, Flux quantization,	TE and TM waves, Rectangular wave guides and cavity resonators. Radiation from Localized Time Varying Sources: Solutions of the inhomogeneous wave equation in the absence of boundaries.
Week 4	revision test of unit 3&4	revision test of molecular	Normal tunneling & Josephson effect, High Tc superconductors, Fullerenes (Elementary idea)	Fields and radiation of a localized oscillating source. Electric dipole and electric quadrupole fields, centre fed linear antenna.

Date: 11-01-2024

Signature

Lesson Plan Session 2023-24

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Manohar Memorial PG College, Fatehabad

Even Semester (UG/PG)

Department Physics

Class : B.Sc. Ist

Class : B.Sc. II nd

Paper : Properties of matter and kinetic theory of gases

Paper : semiconductor devices

Paper : Statistical physics

Paper : Optics II

January 2024

Week 1	Rotation of rigid body, Moment of inertia, Torque, Angular momentum	p-n junction diode and their characteristics, Zener and Avalanche breakdown, Zener diode, Zener diode as a voltage regulator.	Probability and probability theorem, some probability considerations, combinations possessing maximum probability, combinations possessing minimum probability, distribution of N (2,3,4) particles	Phenomenon of double refraction, Huygen's wave theory of double refraction (Normal and oblique incidence),
Week 2	Kinetic energy of rotation. Theorem of perpendicular and parallel axes (with proof), Moment of inertia of solid sphere	Light emitting diodes (LED), Photoconduction in semiconductors, Photodiode, Solar Cell, p-n junction as a rectifier	Micro-Macro states, Thermodynamical probability, Constraints, Accessible states, Case with weightage, statistical function,	Analysis of Polarised light: Nicol prism, Quarter wave plate and half wave plate, production and detection of (i) Plane polarized light
Week 3	Moment of inertia of hollow sphere, spherical shell, solid cylinder, hollow cylinder and solid bar of rectangular cross-section	half wave and full wave rectifiers (with derivation), filter (series inductor, shunt capacitance, L-section or choke, and R.C. filter circuits).	General expression for probability distribution in compartments of different sizes, Postulates of statistical Physics.	(ii) Circularly polarized light and (iii) Elliptically polarized light, Optical activity,

Week 4	Moment of inertia of Fly wheel, Moment of inertia of an irregular body, Acceleration of a body rolling down on an inclined plane		Condition of equilibrium between two systems in thermal contact - β parameter, Entropy and Probability -Boltzmann distribution law.	
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February 2024

Week 1	Elasticity, Stress and Strain. Hooke's law, Elastic constant and their relations, Poisson's ratio, Torsion of cylinder and twisting couple,	Common base, common emitter and common collector characteristics of transistor,	Phase space, Division of phase space into cells, three kind of statistics, basic approach in three statistics, M B statistics a	Fourier theorem analysis of complex waves and its application for the solution of triangular and rectangular waves
Week 2	Determination of coefficient of modulus of rigidity for the material of wire by Maxwell's needle, Bending of beam (Bending moment Cantilever and centrally loaded beam. Determination of Young's modulus for the material of the beam and Elastic constants for the	Constants of a transistor and their relation Advantages and disadvantages of C-E configuration. D.C. load line	M B statistics applied to an ideal gas in equilibrium, energy distribution of law (including evaluation of a and B),	half and full wave rectifier out puts
Week 3		Transistor biasing various methods of transistor biasing and stabilization	speed distribution law, velocity distribution law, their discussion	Fourier analysis Fourier transforms and its properties. Application of Fourier transform to following functions:
Week 4	Assumption of Kinetic theory of gases, Pressure of an ideal gas (no derivation)		Expression for average, rms velocity, expression for average, rms speed in case of MB distribution law.	

March 2024

Week 1	Kinetic interpretation of Temperature, Ideal Gas equation, Degree of freedom. Law of equipartition of energy and its application for specific heat of gases	coupling of amplifiers, various methods of coupling, Resistance-Capacitance (RC) coupled amplifier (two stage, concept of band width, no derivation),	Classical vrs Quantum Statistics, Identical particles, Bose-Einstein statistics, Fermi-Dirac statistics, Application of B.E. Statistics of Planck's radiation law	refraction derivation of thin lens and thick lens formulae, unit plane,
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Week 2	Real gases, Vander Waal's equation, Brownian motion (Qualitative).	Feedback in amplifiers, advantages of negative feedback, emitter follower, distortion in amplifiers.	B.E. gas, M.B. law as a limiting case of B.E. Degeneracy and B.E. Condensation	nodal planes, system of thin lenses
Week 3				FD. Gas, electron gas in metals. Zero point energy, Specific heat of metals and its solution.
Week 4	Holi Vacations			
April 2024				
Week 1	Maxwell's distribution of speed and velocities (derivation)	Condition for self sustained oscillation: Barkhausen criterion for oscillation,	Dulong and petit law, Derivation of Dulong and Petit law. Specific heat at low temperature, Einstein theory of specific heat	Critical angle of propagation. Mode of Propagation. Acceptance angle, Fractional refractive index change.
Week 2		Tuned collector common emitter oscillator		Criticism of Einstein theory, Debye model of specific heat of solid
Week 3	Mean free path, Transport of energy and momentum, Diffusion of gases.	hartley oscillator, C.R.O. (Principle and Working)	Success and shortcomings of Debye, compare of Einstein and Debye theory.	Attenuation, Applications, Fiber optic Communication, Advantages.
	Revision test of unit 1 & 2			

Week 4	Revision test of unit 3 & 4
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Revision tests of soid and nano important topics

Date: 11-01-2024

Lesson Plan Session 2023-24

Class : B.Sc. III rd

Paper : Solid state and Nano Physics

Paper : atomic and molecular physics

Crystalline and glassy forms, liquid crystals, crystal structure, periodicity, lattice and basis, crystal translational vectors and axes. Unit cell and Primitive cell

Winger Seitz primitive Cell, symmetry operations for a two dimensional crystal, Bravais lattices in 2 and 3 dimensions.

Crystal planes and Miller indices, Interplaner spacing,

spectra of Hydrogen atom explanation of spectral series in Hydrogen atom, un-quantized states and continuous spectra, spectral series in absorption spectra, effect of nuclear motion on line spectra (correction of finite nuclear mass)

variation in Rydberg constant due to finite mass, shortcomings of Bohr's theory, Wilson Sommerfeld quantization rule, de-Broglie interpretation of Bohr quantization law. Bohr's corresponding principle, Shortcomings of Bohr-Sommerfeld theory, Vector atom model; space quantization,

electron spin, coupling of orbital and spin angular momentum, spectroscopic terms and their notation, quantum numbers associated with vector atom model, transition probability and selection rules.

<p>Crystal structures of Zinc Sulphide, Sodium Chloride and Diamond.</p>	
<p>X-ray diffraction, Bragg's Law and experimental X-ray diffraction methods. K-space</p> <p>reciprocal lattice and its physical significance, reciprocal lattice vectors</p> <p>reciprocal lattice to a simple cubic lattice, b.c.c. and f.c.c.</p> <p>Historical introduction, Survey of superconductivity, Super conductin systems, High Tc Super conductors,</p>	<p>Penetrating orbits on the classical model; Quantum defect spin orbit interaction energy of the single valance electron spin orbit inter- action <u>for penetrating and non-penetrating orbits</u></p> <p>Hydrogen fine spectra, Main features of Alkali Spectra and their theoretical interpretation, term series and limits. Rydeburg-Ritze combination principle, Absorp- tion spectra of observed doublet fine structure in the spectra of alkali metals and its Interperatation, Intensity rules for doublets, comparison of Alkali Spectra and Hydrogen spectrum.</p>
<p>Isotopic Effect, Critical Magnetic Fiel Meissner Effect, London Theory and Pippards' equation, C</p>	<p>Coupling Schemes; LS or Russell Saunders Coupling Scheme and JJ coupling scheme. Interaction energy in L-S coupling (sp. pd configuration), Lande interval rule. Paull principal and periodic classification of the elements.</p>

<p>Classification of Superconductors (Type I and Type II), BCS Theory of Superconductivity</p>	<p>Interaction energy in JJ Coupling (sp. pd configuration) equivalent and non-equivalent electrons. Two valence electron system-spectral terms of non-equivalent and equivalent electrons,</p>
<p>Flux quantization, Josephson Effect (AC and DC) with derivation</p>	
<p>Definition, Length scale, Importance of Nano-scale and technology History of Nanotechnology, Benefits and challenges</p>	<p>Unit-IV: Atom in External Field Zeeman Effect (normal and anomalous), Experimental set-up for studying Zeeman effect.</p>
<p>Molecular assembler concept, Understanding advance capabilities. Vision and objective of Nano-technology,</p>	<p>Explanation of normal Zeeman effect (classical and quantum mechanical), Explanation of anomalous Zeeman effect (Lande g-factor), Zeeman pattern of D1 and D2 lines of Na-atom, Paschen-Back effect of a single valence electron system. Weak field Stark effect of Hydrogen atom.</p>
<p>Nanotechnology in different fields, Automobile, Electronics, Nanobiotechnology, Material: Medicine.</p>	<p>Molecular Physics General Considerations, Electronic States of Diatomic Molecules, Rotational Spectra (Far IR and Microwave Region) Vibrational Spectra (IR Region) Rotator Model of Diatomic Molecule, Raman Effect, Electronic Spectra.</p>

Revision tests of unit 2 &4

Signature of Head tanya mehta