Lesson Plan

Dr. Sanjay Kumar

Class: B.Sc 2nd **Semester: 4th**

Subject- Statistical physics

Week	Topics
1	Microscopic and Macroscopic systems, events-mutually exclusive, dependent and independent. Probability, statistical probability, A priori probability and relation between them, probability theorem, some probability considerations
2	Combinations possessing maximum probability, combination possessing minimum probability. Tossing of 2,3 and any number of coins, Permutations and combinations.
3	Distribution of N (for N=2,3,4) distinguishable and indistinguishable particles in two boxes of equal size,micro and Macro states, Thermodynamical probability, Constraints and Accessible states
4	Statistical fluctuations, general distribution of distinguishable particles in compartments of different sizes, Condition of equilibrium between two systems in thermal contact- β parameter. Entropy and Probability (Boltzman's relation)
5	Postulates of statistical physics, phase space, Division of phase space into cells, three kind of statistics, basic approach in three statistics. **Class test**
6	M.B. statistics applied to an ideal gas in equilibrium- energy distribution law (including evaluation of α and β), speed distribution law and velocity distribution law.
7	Expression for average speed r.m.s. speed, average velocity. **Assignment**
8	r.m.s. velocity, most probable energy & mean energy for Maxwellian distribution.
9	Need for quantum statistics: Bose-Einstein energy distribution law. Application of B.E. statistics to Planck's radiation law B.E.gas, Degeneracy and B.E. Condensation.
10	Fermi-Dirac energy distribution law, F.D. gas and degeneracy, Fermi energy and Fermi temperature, Fermi-Dirac energy distribution law, Fermi Dirac gas and degeneracy
11	Fermi energy and Fermi temperature; Fermi-Dirac energy distribution law for electron gas in metals, zero point energy, zero point pressure and average speed (at 0 K)of electron gas
12	Specific heat anomaly of metals and its solution. M.B. distribution as a limiting case of B.E. and F.D. distributions, comparison of three statistics
13	Dulong and Petit law. Derivation of Dulong and Petit law from classical physics. Specific heat at low temperature.
14	Einstein theory of specific heat, Criticism of Einstein theory. Debye model of specific heat of solids.
15	Success and shortcomings of Debye theory, comparison of Einstein and Debye theories.

Lesson Plan

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Class-B.Sc 2nd (4th Sem) Subject-Wave and Optics-II

Week	Topics
1	polarization and double refraction, polarisation by reflection, polarisation by scattering, malus law, phenomenon of double refraction
2	Huygen's wave theory of double refraction, analysis of polarised light, Nicol prism, quarter wave plate and half wave plate
3	production and detection of plane polarised light, circularly polarized light and elliptically polarized light
4	optical activity, fresnel theory of rotation, specific rotation, polarimeters, numericals problems
5	Fourier Series, fourier coefficients, odd functions
6	even function, fourier theorem
7	analysis of complex waves and its application for the solution of triangle and rectangular waves
8	half and full wave rectifier outputs,unit Test, numerical problems.
9	fourier transform and its properties
10	Matrix method in paraxial optics, effect of translation and refraction
11	derivation of thin lens and thick lens formula
12	Unit plane nodal planes, system of thin lenses, chromatic, spherical, coma, astigmatism and distortion
13	aberrations, Optical Fibre, critical angle of propagation, mode of propagation, Assignment, Numerical problems.
14	acceptance angle, fractional refractive index change, numerical aperture
15	types of optical fibre, normalised frequency, fibre optic communication, advantages, numerical problems.

Lesson Plan
B.Sc. -3rd 6th semester
Paper:- Atomic and Molecular Physics

Week	Topics
1	Unit first historical background of atomic spectroscopy.Introduction of early observations, emission and absorption spectra, atomic spectra,wave number, spectrum of hydrogen atom in Balmer series,Bohr atomic model.Bohr postulates spectra of hydrogen atom of explanation of spectral series in hydrogen atom and un- quantized states and continuous spectra, correction of finite nuclear mass variation in constant
2	shortcomings of Bohr theory, Wilson sommerfield quantization rule, Di Broglie interpretation of Bohr quantization Law, Bohr corresponding principal.
3	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 rule
4	Orbital magnetic dipole moment, Bohr magnetic, Behaviour of magnetic dipole in external magnetic field ,Larmor precession and theorem. penetrating and non penetrating orbits.
5	penetrating orbits on the classical model Quantum defect spin Orbit interaction energy of the single valence electron spin interaction of penetrating and non penetrating orbits quantum mechanical relativity correction. Hydrogen fine spectra ,main features of alkali spectra and their theoretical interpretation term series and limits
6	absorption spectra of alkali atoms observed doublet fine structure in the spectra of alkali metals and its interpretation. intensity is rule for doublets, comparison of alkali spectra and hydrogen spectrum
7	Problem Discussion of unit-1 & unit-2, unit test, Assignment
8	Essential feature of spectra of alkaline earth elements vector model for two valence electron atom: application of spectra, LS coupling& J-J coupling
9	interaction energy in LS coupling (sp. pd) configuration land interval rule, Pauli principle and periodic classification of the element interaction energy. interaction energy in JJ coupling as (sp.pd) configuration.
10	equivalent and non-equivalent electrons . comparison of spectral terms in LS and JJ coupling. hyperfine structure of spectral lines and its origin isotope effect ,nuclear spin
11	Zeeman effect(normal and Anomalous) experimental setup for studying zeeman effect. explanation of normal Zeeman effect
12	Classical and Quantum mechanical explanation of Anomalous Zeeman effect. lande factor and pattern of D1 and D2 lines of Na atom. Paschen -back effect of a single Valence Electrons system, weak field stark effect of hydrogen atom
13	General considerations, electronic states of diatomic molecules, rotational spectra (far IR and microwave region)
14	Numerical discussion , problem discussion of all three units

LESSON PLAN

B.Sc. -3rd 6th semester

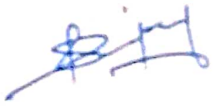
Paper:- Solid State Physics

Week	Topics
1	Crystalline and Glassy forms, liquid crystals. crystal structure, periodicity, lattice and basis crystal translational vectors and axes. unit cell and primitive cell, Winger Seith primitive cell symmetry operation for a two dimensional crystal
2	Bravais lattice in two and three dimensions. Crystal plane and Miller Indices Interplanar spacing
3	crystal structure of sodium chloride and diamond and Zine sulphide. Problem discussion of unit -1
4	X-ray diffraction Bragg's law and experimental x-ray diffraction method k-space reciprocal lattice and its physical significance of reciprocal lattice vectors. reciprocal lattice to a simple cubi,c BCC,FCC
5	reciprocal lattice and its physical significance of reciprocal lattice vectors reciprocal lattice to a simple cubic
6	reciprocal lattice to a lattice BCC reciprocal lattice to a FCC
7	Problem Discussion of unit-1 & unit-2, unit test, Assignment Submission
8	Unit III superconductivity Historical introduction, Survey of superconductivity. superconducting system. high temperature superconductors, isotopic effect critical magnetic field
9	Meissner effect, London's theory and peppard equation classification of superconductors (Type 1 and Type II
10	BCS theory of superconductivity ,flux quantization, josephson effect(AC and DC) practical application of superconductivity and their limitations power applications of superconductors
11	Practical application of superconductivity and their limitations. power applications of superconductors, Numerical discussion ,class test of unit-3
12	Definition, length scale, importants of nano scale and Technology. history of Nano Technology. benefits and challenges in molecular manufacturing. molecular assembler concept
13	understanding advanced capability. Vision and objectives of Nanotechnology Nanotechnology in different field like automobile
14	Nanotechnology in electronics, Nanotechnology in Nano-biotechnology ,nanotechnology in material, Nano- technology in medicine
15	Problem discusion of unit-4,class test of unit-4

Lesson Plan

BSc-2nd Year, Sem-3rd **Paper:- Wave and Optics-I**

Week	Topics
1	Interference by division of wavefront, young double slit experiment, coherence, conditions of interference
2	Fresnel biprism, determination of wavelength of light
3	determination of thickness of Mica sheet, Lloyd mirror
4	difference between biprism and Lloyd mirror fringes, phase change on reflection, Discussion of numerical problems.
5	interference by division of amplitude, thin film, plane parallel film
6	interference due to transmitted light, wedge shaped film
7	Newton's ring, Michelson interferometer
8	standardization of a meter, determination of wavelength
9	Huygens Fresnel theory, Fresnel's assumptions, rectilinear propagation of light
10	Fresnel half period zones, zone plate, Unit test, numerical problems
11	diffraction at a straight edge, rectangular slit and diffraction at a circular aperture
12	diffraction due to narrow slit, diffraction due to narrow wire
13	Fraunhoffer diffraction, single slit diffraction, double slit diffraction
14	N slit diffraction, plane transmission grating spectrum, Assignment, Numerical problems.
15	dispersive power of a grating, limit of resolution
16	Reyleigh criterion, resolving power of a telescope and a grating, difference between prism and grating spectra



Lesson Plan Session 2023-24

Lesson Plan

BSc-2nd Year, Sem-3rd Computer programming and thermodynamics physics

Week	Topics
1	Computer organization, binary representation, algorithm development, flow chart and their interpretation.
2	FORTRAN preliminaries: integer and floating point, arithmetic expression built in functions, executable and non executable statements
3	Input and output statements, formats, IF, DO, and GOTO statements dimension arrays
4	Statement function and function subprogram algorithm, flow chart and programming for print out of natural numbers
5	Range of set of given numbers ascending and descending order,Mean and standard deviation
6	Least square fitting of curve,Roots of quadratic equation, Product of two matrices.
7	Numerical integration (Trapezoidal rule and Simpson 1/3 rule)
8	Thermodynamic system and Zeroth law of thermodynamic, first law of thermodynamics and its limitations reversible and irreversible process.
9	Second law of thermodynamics and its significanceCarnottheorem, absolute scale of temperature absolute zero and magnitude of each division on work scale and perfect gas scale
10	Joule's free expansion, Joule's Thomson effect, Joule's Thomson (porous plug) experiment conclusions and explanations
11	Analytical treatments of joule Thomson effect, entropy, calculationsof entropy of reversible process, T-S diagram, entropy of a perfect gas, Nernst heat law
12	Liquefaction of gases (oxygen, air, hydrogen and helium) Solidification of He below 4k, cooling by adiabatic demagnetization.
13	Deviation of Clausius-Clapeyron and Clausius latent heat equation and their significance, specific heat of saturated vapors phase diagram and triple point of a substance
14	Development of Maxwell thermodynamical relation Thermodynamical functions: internal energy (U), Helmholtz function(f), enthalpy(H), Gibbs function(G), and the relation between them, Derivation of Maxwell thermodynamical relations from thermodynamical functions.
15	Applications of Maxwell relation: relation between two specific heats of gas, Derivation of Clausius-Clapeyron and Clausius equation, variation of intrinsic energy with volume for (i) Perfect gas (ii) Vander Waals gas (iii) Solids and liquids, derivation of Stefan's law, adiabatic compression and expansion of gas and deduction of theory of joule's Thomson effect.

Lesson Plan

BSc-3rd Year, Sem-5th **Quantum Mechanics and Laser Physics**

Week	Topics
1	Unit 1: Scale of Quantum Physics, Boundary between Classical and quantum phenomena
2	Photoelectric effect, Compton effect, Frank Hertz expt., de Broglie hypothesis, Davison and Germer expt., G P Thomson expt.,
3	Phase Velocity and group velocity and their relation, Heisenberg's uncertainty Principle, time energy and angular momentum, uncertainty principle from de-Broglie wave
4	Gamma Ray microscope, electron diffraction from a slit, Derivation of 1D time dependent SWE, Time independent SWE, eigen value and eigen function
5	Orthogonality and normalization of a function, expectation value of a dynamical quantities, Probability current density, Numerical and doubts
6	Unit 2: Free Particle in 1D box, Quantization of energy and momentum, nodes and anti nodes, zero point energy,
7	1D Step Potential E> V0, E<V0
8	1D potential Barrier E> V0, E<V0
9	Solution of SWE for Harmonic Oscillator, Unit Test
10	Unit 3: Absorption and emission of Radiation, Main features of Laser, directionality, high Intensity, high degree of Coherence,
11	Spatial and temporal coherence, Einstein coefficients and possibility of amplification, momentum transfer,
12	Life time of level, kinetics of optical absorption, population inversion, resonance cavity, laser pumping, threshold condition for laser emission
13	Line Broading mechanism, homogenous broadening, inhomogeneous broadening, revision
14	Ruby laser, Optical Properties of semiconductors,
15	He-Ne Laser, CO2 Laser, Application of laser

Lesson Plan

BSc-3rd Year, Sem-5th **Paper:- Nuclear Physics**

Week	Topics
1	Unit 1: Nuclear Composition, Mass and Binding Energy, Numerical Problems, Nuclear binding energy and stability curve
2	Nuclear Size, Spin, Parity, Statistics, magnetic dipole moment, quadruple moment
3	Determination of mass by Bain- Bridge and Jordon mass spectrograph, determination of charge by Mosely Law
4	Determination of size of nucleus by Rutherford back scattering, Numerical Problems, discussion and doubts
5	Unit 2: Alpha-disintegration and its theory, Energetics of alpha decay, origin of continuous beta spectrum, types of beta decay and energetic of beta decay
6	Nature of Gamma rays, energetic of gamma rays, interaction of heavy charged particles (alpha particles), energy loss of heavy charged particles, Range and straggling of alpha particles
7	Interaction of light charged particles (beta particles) energy loss of beta particles, range of electrons, absorption of beta particles, interaction of gamma rays: passage of gamma rays through matter
8	Photoelectric effect, Compton effect, pair production, electron-positron annihilation, Absorption of gamma rays: mass attenuation coefficient and its application, Numerical Problems, discussion and doubts
9	Unit 3: Linear Accelerator, tendon accelerator, cyclotron and betatron accelerator
10	Ionization chamber, proportional counter, G.M. counter,
11	Scintillation counter and semiconductor counter, Numerical Problems, discussion and doubts
12	Unit 4: Nuclear reactions, elastic scattering, inelastic scattering,
13	Nuclear disintegration, photo-nuclear reaction, radiative capture, Direct-reaction,
14	Heavy–ion reactions and spallation reactions, conservation laws, Q-value and reaction Threshold
15	Nuclear Reactors, General aspects of Reactor Design, Nuclear fission reactors
16	Nuclear Fusion reactors, Numerical Problems, discussion and doubts