

Teaching Plan for ODD Semesters w.e.f. November 2023

Name: M Jani Baig

Designation: Associate Professor

B.Sc. V Semester; Paper 5.1 & 5.2 – Teaching Plan

November 2023

Paper: 5.2 – Unit: 01 & 02

08 hours

Basic Atomic models: Thomson's atomic model; Rutherford atomic model – Model, Theory of alpha particle scattering, Rutherford scattering formula; Bohr atomic model – postulates, Derivation of expression for radius, total energy of electron; Origin of the spectral lines; Spectral series of hydrogen atom;

December 2023

Paper: 5.2 – Unit: 02 & 03

32 hours

Effect of nuclear motion on atomic spectra - derivation; Ritz combination principle; Correspondence principle; Critical potentials – critical potential, excitation potential and ionization potential; Atomic excitation and its types, Franck-Hertz experiment; Sommerfeld's atomic model – model, Derivation of condition for allowed elliptical orbits. **Vector Atom Model & Optical Spectra:** Vector atom model – model fundamentals, spatial quantization, spinning electron; Quantum numbers associated with vector atomic model; Coupling schemes – L-S and j-j schemes; Pauli's exclusion principle; Magnetic dipole moment due to orbital motion of electron – derivation; Magnetic dipole moment due to spin motion of electron; Lande g-factor and its calculation for different states; Stern-Gerlach experiment – Experimental arrangement and Principle; Fine structure of spectral lines with examples; Spin-orbit coupling / Spin-Orbit Interaction – qualitative; Optical spectra – spectral terms, spectral notations, selection rules, intensity rules; Fine structure of the sodium D-line; Zeeman effect: Types, Experimental study and classical theory of normal Zeeman effect, Zeeman shift expression (no derivation), examples; Stark effect: Experimental study, Types and examples

Molecular Physics: Types of molecules based on their moment of inertia; Types of molecular motions and energies; Born-Oppenheimer approximation; Origin of molecular spectra; Nature of molecular spectra; Theory of rigid rotator – energy levels and spectrum, Qualitative discussion on Non-rigid rotator and centrifugal distortion;

January 2024

Paper: 5.2 – Unit: 04

32 hours

Paper: 5.1 – Unit: 01

Theory of vibrating molecule as a simple harmonic oscillator – energy levels and spectrum; Electronic spectra of molecules – fluorescence and phosphorescence; Raman effect – Stoke's and anti-Stoke's lines, characteristics of Raman spectra, classical and quantum approaches, Experimental study of Raman effect; Applications of Raman effect.

LASER Physics: Ordinary light versus laser light; Characteristics of laser light; Interaction of radiation with matter - Induced absorption, spontaneous emission and stimulated emission with mention of rate equations; Einstein's A and B coefficients – Derivation of relation between Einstein's coefficients and radiation energy density; Possibility of amplification of light; Population inversion; Methods of pumping; Metastable states; Requisites of laser – energy source, active medium and laser cavity; Difference between Three level and four level lasers with examples; Types of lasers with examples; Construction and Working principle of Ruby Laser and He-Ne Laser; Application of lasers (qualitative) in science & research, isotope separation, communication, fusion, medicine, industry, war and space. **Introduction to Newtonian Mechanics:** Mechanics of single particle and system of particles (in both cases), Conservation of linear momentum, Angular momentum and energy.

Lagrangian formulation: Constraints – Holonomic constraints, non-holonomic constraints, Scleronomic and Rheonomic constraints with suitable examples. Degrees of freedom. Generalized coordinates, displacement, velocity, acceleration, force, potential, virtual displacement, Principle of virtual work, D'Alembert's principle (derivation),

February 2024

Paper: 5.1 – Unit: 01 & 02

18 hours

Lagrange equations for conservative system and non-conservative system (derivation). Applications of Lagrangian formulations: 1) Newton's equation of motion (for single particle in one dimension in cartesian coordinates and polar coordinates). 2) Simple pendulum (expression for acceleration), 3) Atwood's machine (expression for common acceleration) and 4) linear harmonic oscillator (derivation in each case). Advantages of Lagrangian formulations.

Relativity: Newtonian principle of relativity. Non-Inertial Systems: Non-inertial frames and fictitious forces. Uniformly rotating frame- Expression for Coriolis force.

Special Theory of Relativity: Michelson-

Morley Experiment and its outcome. Postulates of Special Theory of Relativity. Lorentz Transformation equations (Quantitative). Relativity of Simultaneity. Lorentz contraction. Time dilation. Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. Transformation of Energy and Momentum. Relativistic Doppler effect: Longitudinal Doppler Effect- Expression for apparent frequency. Relativistic Kinematics.

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