

**M.Sc. Physics Semester II Paper IX**  
**Atomic and Molecular Physics 22PHY22C3**

Theory Marks:80  
Internal Assessment Marks:20  
Time: 3 Hours

**COURSE OUTCOMES**

The student will be expected to be able to explain:

- CO1 Atomic spectra of one and two electron atoms.
- CO2 The change in behavior of atoms in external applied electric and magnetic field.
- CO3 Diatomic molecules and their rotational vibrational and rotational vibrational spectra.
- CO4 Energy levels and spectrum in diatomic molecules

**Unit I**

One Electron systems and Pauli principle: Quantum states of one electron atoms, atomic orbitals, Hydrogen spectrum, Pauli principle, spectra of alkali elements, spin orbit interaction and fine structure in alkali spectra, Spectra of two electron systems, equivalent and non-equivalent electrons

**Unit II**

The influence of external fields, Two electron system Hyperfine structure and Line broadening: Normal and anomalous Zeeman effect, Paschen Back effect, Stark effect, Two electron systems, interaction energy in LS and JJ coupling, Hyperfine structure (magnetic and electric, only qualitative)

**Unit III**

Diatomic molecules and their rotational spectra: Types of molecules, Diatomic linear symmetric top, asymmetric top and spherical top molecules, Rotational spectra of diatomic molecules as a rigid rotator, energy levels and spectra of non-rigid rotor, intensity of rotational lines

**Unit IV**

Vibrational and Rotational Vibration spectra of Diatomic molecules: Vibrational energy of diatomic molecule, Diatomic molecules as a simple harmonic oscillator, Energy levels and spectrum, Morse potential energy curve, Molecules as vibrating rotator, vibration spectrum of diatomic molecules, PQR Branches

**Note:** The syllabus is divided into four units. Nine questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit. A student has to attempt five questions in all.

**Text and Reference Books:**

- [1] Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
- [2] Introduction to Atomic spectra by H.E. White
- [3] Fundamentals of molecular spectroscopy by C.B. Banwell
- [4] Spectroscopy Vol I and II by Walker and Straughen
- [5] Introduction to Molecular spectroscopy by G. M. Barrow
- [6] Spectra of diatomic molecules by Herzberg
- [7] Molecular spectroscopy by Jeanne. L. McHale
- [8] Molecular spectroscopy by J.M. Brown
- [9] Spectra of atoms and molecules by P. F. Bemath
- [10] Modern spectroscopy by J.M. Holias