19BSP502T Atomic and Molecular Physics

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory		Internal	Term Work	Practical/Viva	Total Marks
					MS	ES				
4	0	0	4	4	25	50	25	--	---	100

Course Objective:

1. To introduce students with various atomic models.
2. To recognize and analyze the atomic structure and formation of atomic spectra.
3. To examine the molecular symmetry and build the solid concepts of matter and radiation interactions.
4. To empower students to be able to appraise the various spectroscopic techniques.

UNIT I Atomic structure **[15]**

An introduction to various atomic models, Rutherford's model, Bohr's postulates and theory of spectra like hydrogen atom, electron energy levels and their spectral series in hydrogen atom, De Broglie hypothesis, correction for the finite mass of the nucleus, variation of Rydberg constant, Wilson-Sommerfeld Quantization Rules, Bohr's correspondence principle, Sommerfeld's extension of Bohr's model, quantum numbers associated with vector atom model, orbital angular momentum, types of spectra, Larmor precession, Electron spin, Space quantization, Vector atom model, quantum numbers associated with vector atom model.

UNIT II Atomic Structure and Spectra **[13]**

Spin orbit interaction, Quantum-mechanical Relativity Correction, Introduction to L-S coupling, J-J coupling, Hydrogen Fine Structure, Total angular momentum in many electron atoms, Pauli exclusion principle, Electron configuration, Hund's rule, Energy levels and transitions of Helium, Alkali spectra, Shielding of core electrons, Selection rules (derivation from transition probabilities).

UNIT III Atomic Spectroscopy **[12]**

Normal Zeeman effect, experimental arrangement and theory, Anomalous Zeeman effect, Paschen-Bach effect, Stark effect, Characteristics X-ray spectrum, Moseley's law, Width of spectral lines, Compton scattering, Braggs law, Determination of wavelength of X-rays by crystal diffraction method, Energy levels and characteristic X-ray lines, X-ray absorption spectra, Auger effect, Metastable states, Spontaneous and Stimulated emissions.

UNIT IV Molecular Spectra and Raman effect **[20]**

Separation of electronic and nuclear motion - The Born Oppenheimer approximation, types of molecular spectra, Rotational energy levels, Pure Rotational spectra, Molecule as a rigid rotator, the non-rigid rotator, Isotope effect on rotational spectrum , Vibrational energy levels, Molecule as a harmonic oscillator, Molecule as anharmonic oscillator , Vibration-Rotation spectra, Fine structure of Infrared bands: Molecule as vibrating rotator, Electronic spectra, Frank-Condon principle, Raman effect, Classical theory of Raman effect, Pure rotational Raman spectra, Vibrational Raman spectra, Experimental set up for Raman effect, Applications of Raman effect, Fluorescence and Phosphorescence. **Total: 60 Hrs**

Course Outcome:

On completion of the course, students will be able to

1. Describe basic concepts of atomic structure and differentiate between various atomic models.
2. Demonstrate how coupling and interaction between the electron's spin and orbit affects atomic structure and spectra.
3. Categorize various atomic spectra and their mechanism for their wide ranging applications.
4. Relate the symmetry of molecules with the interaction between matter and radiation.
5. Interpret various molecular spectra and some basic principle behind them.
6. Apply the knowledge of Atomic and molecular spectroscopy in solving day to day problem of life.

Reference Books:

1. Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 1987).
2. Atomic physics by J. B. Rajam & foreword by Louis De Broglie (S. Chand & Co., 2007).
3. Introduction to Atomic Spectra by H. E. White (McGraw Hill Book Company).
4. Fundamentals of Molecular Spectroscopy by C. N. Banwell and E. M. McCash (Tata McGraw Hill, 1994)
5. Engineering Physics by R. K. Gaur and S. L. Gupta (Dhanpat Rai Publication, 2009).
6. Introduction to Molecular Physics by G. M. Barrow (McGraw Hill Book Company, 2017).
7. Spectrophysics by Anne P. Thorne (Chapman and Hall, 2013).
8. Atomic and Molecular Physics by Raj Kumar (Campus Books International, 2003).
9. Atomic Physics by S. N. Ghoshal (S. Chand, 2016).