

Course Type	Course Code	Name of Course	L	T	P	Credit
DC	NPHC515	ATOMIC AND MOLECULAR PHYSICS	3	1	0	4

<b>Course Objective</b>
Atomic and molecular physics topics covered here deals with the observation and interpretation of radiation absorbed or emitted by atoms or molecules. This information can lead into the knowledge of structure and properties of the atom/molecule.
<b>Learning Outcomes</b>
The course will enable the student to get an idea about atomic and molecular spectra, spin orbit interaction, fine and hyperfine structure of spectral lines, Zeeman and Stark effects, line broadening mechanisms, Raman spectra and Mossbauer spectroscopy.

Unit No.	Topics to be Covered	Lecture + Tutorial Hours	Learning Outcome
1	Vector atom model, Quantum states of one electron atoms-Atomic orbitals, Hydrogen spectrum-Pauli's principle.	4+1	This topic covers the introduction to atomic models, quantum states of hydrogen like atoms and hydrogen spectrum.
2	Spin orbit interaction and fine structure in alkali Spectra, intensity rules – Equivalent and non-equivalent electrons. Interaction energy in LS and jj Coupling – Hyperfine structure	7+3	This unit will help to understand the fine structure and hyperfine structure in atomic spectra and the interaction energy in L-S and j-j coupling.
3	Zeeman effect – Splitting of spectral lines in presence of weak and strong magnetic field, Stark effect, Two electron systems.	6+2	In this topic, students will learn about the removal of degeneracy using magnetic and electric fields.
4	Broadening of spectral lines– Line broadening, Doppler and Lorentz Broadening mechanisms.	3+1	The broadening of spectral lines is learned in this unit.
5	Molecular spectra, Rotational spectra of diatomic molecules as a rigid rotator using Schrodinger wave equation and non-rigid rotator, intensity of rotational lines, Frank-Condon principle.	7+2	This topic introduces molecular spectroscopy. The rotational spectra of diatomic molecules are explained quantum mechanically. It also discusses Frank-Condon principle.
6	Vibrational-rotational spectra, vibrational energy of diatomic molecule-Diatomic molecule as a simple harmonic oscillator, Effect of anharmonicity, Energy levels and spectrum-Morse potential, energy curve-Molecules as vibrating rotor- Vibration spectrum of diatomic molecule. Raman spectroscopy, Rotational and vibrational Raman spectra of diatomic molecules.	9+4	Vibrational-rotational spectra of diatomic molecules are learned in this unit. Raman spectroscopy of diatomic molecules are also considered here.
7	Effect of Nuclear spin on intensities of Rotational Raman spectra; Mossbauer spectroscopy.	6+1	The effect of nuclear spin in spectra is discussed in this unit.
<b>Total</b>		<b>42+14</b>	

#### Text Books:

1. Introduction to Atomic Spectra; White; McGraw-Hill Education; 1934.
2. Atomic Spectra And Atomic Structure; Herzberg; Dover; 2008
3. Physics of Atoms and Molecules; Bransden and Joachain; Pearson; 2006.

#### Reference Books:

1. Fundamentals of Molecular Spectroscopy; Banwell; McGraw-Hill Education Ltd; 2000.
2. Introduction to Molecular Spectroscopy; Barrow; McGraw-Hill Education; 1962.
3. Lasers - Fundamentals and Applications: Thyagrajan & Ghatak; Springer; 2010.
4. Chemical Applications of Group Theory; Cotton; Wiley India Pvt Ltd; 2009.
5. Modern Spectroscopy; Hollas; Wiley India Pvt Ltd; 2010.
6. Atomic & Molecular Spectra; Raj Kumar, KedarNath, Ram Nath, New Delhi, 1997.