

SEMESTER - I

Paper - III : Applied Spectroscopy

Max. Marks : 55

Time : 3 Hrs

Note : Nine questions will be set and students will attempt 5 questions. Question No. 1 will be compulsory consisting of 4 parts based on the conceptual aspects of the whole syllabus. The answers should not be in yes/no. In addition to Question No. 1 there will be four Units in the question-paper each containing two questions belonging to four Units in the syllabus. Students will select one question from each unit.

UNIT - I

Molecular spectroscopy: Rotation of molecule, Rotational spectra, Rigid diatomic molecule, Intensities of spectral line, Effect of isotopic substitution, Non-rigid rotation. Spectrum of non-rigid rotator. Vibrating diatomic molecule, energy of a diatomic molecule, Harmonic oscillator. Anharmonic oscillator.

Diatomic vibrating rotator, Breakdown of the Born-Oppenheimer approximation, Interaction of rotation and vibration, Vibration of polyatomic molecules, Fundamental vibrations and their symmetry, overtones and combination frequencies, influence of rotation on the spectra of polyatomic molecules, influence of nuclear spin.

UNIT - II

Raman spectroscopy: Classical theory of Raman effect, Rayleigh scattering, stoke and antistoke lines, molecular polarizability, pure rotational Raman spectra of linear symmetric top molecules. Vibrational Raman spectra, Raman Activity of vibrations, Rule of mutual exclusion, Rotational fine structure, Advantages and limitations of Raman spectroscopy, Comparison between Raman spectra and Infra red spectra.

UNIT - III

Electronic spectroscopy of molecules: Electronic spectra of diatomic molecules, The Born-Oppenheimer approximation Vibrational Coarse structure, Progression, Intensity of vibrational - Electronic spectra, Frank-Condon Principle.

Resonance spectroscopy : Spin and applied field, Interaction between spin and magnetic field, Larmor precession, Electron spin resonance, Position of electron spin resonance absorptions, 'g' factor, Factor affecting 'g' value
Limitation of ESR, ESR spectrometer. Application of ESR.

UNIT - IV

Nuclear magnetic resonance spectroscopy: Nuclear spin, Magnetic moment, Nuclear magnetic resonance, magnetic moment and magnetic field, Theory of NMR spectra. Chemical shift, Spin-spin splitting, Shielding and deshielding of magnetic nuclei, NMR spectrometer
Limitation of NMR spectroscopy, Application of NMR.

Mössbauer spectroscopy: Natural line width, Recoil energy loss, Resonance and resonance fluorescence, Mössbauer effect, Basic principle, Spectrometer, Lamb Mössbauer factor, Application of Mössbauer spectroscopy.

References

1. Fundamental of Molecular spectroscopy - Colin N. Banwell and Elaine M. McCash, McGraw - Hill.
2. Molecular spectra and molecular structure - Gerhard Herzberg.
3. Introduction to molecular spectroscopy, theory and experiment. E.F. Brittan, W.O. George and C.H. Wells, Academic Press.
4. Principles of Instrumental Analysis - Douglas A. Skoog, F. James Holler, Timothy A. Nieman Saunders Publishing
5. Basic Principles of Spectroscopy - R. Chang, Krieger Publication.