Course 7: Spectroscopy
Course code: MSCPH507 **Credit: 3**

BLOCK 1 Basic Spectroscopy and H, He atom spectra

Unit –1: **Fine spectrum of Hydrogen and Helium:** Introduction, Spin orbit interaction, Fine spectrum of hydrogen, Identical particles: exchange symmetry of wave fuctions, Pauli's principle, Hund rule, Helium atom and its spectrum.

Unit –2: **Spectroscopic Terms:** Spectroscopic terms, L-S coupling, Lande interval rule, Normal and inverted multiplets, determination of spectral terms, selection rules in L-S coupling, j-j coupling, selection rule in j-j coupling.

Unit –3: **Spectra of Alkali Elements:** Broad features of alkali spectra, Ritz combination principle, Doublet structure of the alkali spectra, compound doublet, intensity rule of spectral line, theoretical interpretation of alkali series, Interaction energy in L-S and j-j coupling.

BLOCK 2 Zeeman, Stark effect and X ray

Unit –4: **Zeeman Effect:** Zeeman Effect, Classical interpretation of normal Zeeman effect, Vector model of normal and anomalous Zeeman effect, Explanation of anomalous Zeeman effect, Explanation of normal Zeeman effect, Paschen-back effect, Spin orbit correction.

Unit –5: **Stark Effect:** Stark effect, Stark effect in Hydrogen atom, Weak and strong field Stark effect in Hyderogen, Quantum mechanical treatment of Stark effect, Hyperfine structure.

Unit –6: **Breadth of Spectra Lines:** Introduction to breadth of spectral lines, Causes of spectral line, Natural width, Doppler width, External factors affecting width of the line.

Unit –7: **X Ray Spectra:** X ray spectra, line spectra, X ray emission spectra, Moseley law, X ray absorption spectra, X ray continuous spectra, optical spectra. .

BLOCK 3 Molecular Spectra and Raman Effect

Unit–8: **Molecular Energy State and Molecular Spectra**: Types of molecular spectra, Types of molecular energy state and associated spectra, Born-Oppenheimer approximation

Unit –9: **Pure Rotational Spectra:** Pure rotation spectra: Salient features of the rotational spectra, Spectra for rigid and non rigid rotation, Isotope effect.

Unit –10: **Vibrational Spectra:** Vibrational-Rotational spectra, Salient features of the vibrational-rotational spectra, Molecules as harmonic oscillator, Molecules as anharmonic oscillator, Force constant for anharmonic oscillator, Problems on force constant, Isotope effect on vibration level, Fine structure of infrared bands.

Unit –11: **Raman Spectra:** Raman Effect, Classical and quantum theory of Raman Effect, Vibrational and rotational Raman spectra.

BLOCK 3 Franck-Condon principle and photoacoustic effect

Unit –12: **Electronic spectra:** Electronic spectra, Salient features of molecular electronic spectra, Formation of Electronic spectra, band system, Frack-condon principle, sequence and progression, Condon parabola

Unit –13: **Photoacoustic:** Introduction to Photoacoustic effect, Explanation of Photoacoustic effect, Application of Photoacoustic effect.

Reference Books:

1. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, Tata McGraw-Hill Publications, New Delhi.
2. G. Aruldas, Molecular Structure and Spectroscopy, Prentice - Hall of India Pvt. Ltd., New Delhi.
3. D.N. Satyanarayana, Vibrational Spectroscopy and Applications, New Age International Publications, New Delhi.
4. Raj Kumar, Atomic and molecular spectroscopy, Ramnath Kedarnath Publication, Delhi