iii. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).

iv. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

v. M. Hosokawa, K. Nogi, M. Naita, T. Yokoyama, Nanoparticle Technology Handbook (Elsevier, 2007).

vi. Introduction to Nanoelectronics, V.V. Mitin, V.A. Kochelap and M.A. Stroscio, 2011, Cambridge University Press.

vii. Bharat Bhushan, Springer Handbook of Nanotechnology (Springer-Verlag, Berlin, 2004).

viii. Guozhong Cao, Wang, Ying, Nanostructures And Nanomaterials: Synthesis, Properties, And Applications (2nd Edition) (World Scientific Series in Nanoscience and Nanotechnology), January 2011

ix. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, November 2014, Springer.

PHYDSC454T

ATOMIC AND MOLECULAR PHYSICS

Contact Hours: 60

Full Marks = 100 [ESE (70) CCA(30)]

Course objective: *This course introduces students to the basic physics of atoms, molecules, their spectra and the interaction of light with matter including the study of influence of electric and magnetic fields on atoms with the help of understanding Stark effect and Zeeman effect.*

Unit 1:

Review of atomic models and concepts, Hydrogen spectrum from the Bohr and Bohr-Sommerfeld theories, Variation of the Rydberg constant, Unquantized states and continuous spectra, Larmor's precession, Space quantization, Electron spin, Stern-Gerlach experiment. Magnetic moment of atom (one and two electrons system), Quantization of magnetic moment.

(12 Lectures)

Unit 2:

Excitation & Ionization potentials, Frank and Hertz experiment. Characteristics X-ray spectra, Moseley's law, Difference between continuous & characteristics X-ray spectra. Moseley's law. Effect of nuclear motion on atomic spectra. Reduced mass, modified Rydberg constant and wave number, Evidences in favour of Bohr's theory. Correspondence principle. Zeeman Effect and its Experimental arrangement. Anomalous Zeeman effect. Classical & quantum treatment of normal Zeeman Effect. **(12 Lectures)**

Unit 3:

Paschen-Back effect, Stark effect. Spin orbit coupling - LS and JJ coupling schemes. Spectral notations for atomic states. Lande Interval rule. Normal and inverted multiplets. Spectra of alkali

atoms: Characteristic features, term value, Selection and intensity rules. Pauli's exclusion principle and its explanation. Justification of Periodic arrangement of atoms by Pauli's exclusion conclusion. Hund's rule. **(12 Lectures)**

Unit 4:

Born-Oppenheimer approximation, Origin of molecular spectra, Fluorescence and phosphorescence, Rotational Spectra (Rigid and non-rigid rotator approximations). Vibration Rotational levels in a vibrating and rotating diatomic molecule. Rotational spectra of Polyatomic molecules, Isotopic effect on rotational spectra, Vibrational spectra (Harmonic and anharmonic approximations), Rotational-Vibrational spectra. **(12 Lectures)**

Unit 5:

UV Spectroscopy: Electronic spectra in emission and absorption, Vibrational and rotational structures of electronic bands, Frank-Condon Principle and its applications. Isotopic effect on electronic spectra, Molecular electronic states.
Raman Effect and Raman spectroscopy. Classical theory of Raman effect, Vibrational Raman spectrum, selection rules, Stokes & anti-Stokes lines, intensity of anti-stokes line. **(12 Lectures)**

Expected learning outcomes: *At the end of this course the students are expected to learn concepts various atomic models with their limitations, space quantization, Effect of nuclear motion on atomic spectra, the atomic spectra of one and two valance electron atoms, L-S and J-J couplings, Origin of molecular spectra and Raman effect.*

Reference Books:

i. Atomic Physics, J. B. Rajam, S. Chand Publication.
ii. Atomic & Molecular Spectroscopy, Rita Kakkar, Cambridge Univ. Press.
iii. Atomic & molecular Physics, R. K. Tripathi, Crescent Publishing.
iv. Atomic & Molecular Spectra Laser, Raj Kumar, Kedar Nath Ram Nath Publisher.
v. Atomic and Molecular Spectra and Lasers, A. K. Saxena, CBS Publisher.
vi. Atomic spectra and atomic structure, Herzberg, Dover Publication.

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