SECOND SEMESTER 2015 – 2016

Course Handout (Part – II)

Date: 05/01/2016

In addition to Part I (general Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No.: **PHY F342**
Course Title: **Atomic and Molecular Physics**

Instructor-in-charge : Srijata Dey
Instructors: Rakesh Choubisa, Srijata Dey

Scope and Objectives of the course

The aim of this course is to present a unified account of the physics of atoms and molecules in adequate detail, but keeping within the undergraduate framework. The basic atomic physics includes discussions of atomic structure, the optical spectra of atoms, the interaction of atoms with electromagnetic radiation. The molecular physics part includes structure of molecules and various molecular spectroscopies.

Text Book:

Physics of Atoms and Molecules, B.H.BRANSDEN & C.J. JOACHAIN, Second Edn.,Pearson Education Ltd.

Reference Books:

1. *Molecular Spectroscopy,* Suresh Chandra, Narosa Publishing House Pvt. Ltd.
2. *Fundamentals of Molecular Spectroscopy, C. N. BANWELL and E. M. McCASH*, Fourth Edn., Tata McGraw-Hill Publishing Company Ltd., New Delhi.

Course Plan

Lecture No.	Learning Objectives	Topics to be covered	Reference Chapter/ Section
1-3	One-electron atoms	Schrödinger equation, energy levels, eigenfunctions of bound states, expectation values, special hydrogenic systems	T.B. Chp3. 3.1-3.6
4-12	Interaction of one-electron atoms with e.m. radiation	Interaction of e.m. field with charged particles, transition rates, dipole approximation, the Einstein coefficients, Selection rules, line shapes and widths	T.B. Chp.4 4.1-4.7
13-17	Fine structure & hyperfine structure	Fine structure of hydrogenic atoms, the Lamb shift, Hyperfine structure and isotope shifts	T.B. Chp.5 5.1-5.3
18-23	Two-electron atoms	Schrödinger equation, spin wave functions, level scheme, ground state and excited states of two-electron atoms.	T.B. Chp.7 7.1-7.6

24-26	Quantum theory of valence	Molecular orbital (MO)method, H_2 molecular ion, H_2 molecule, diatomic molecular orbitals, MO energy level diagrams, Valence bond method, directed bonds, hybridization	Ref.1. Chp.: II 1.-8.
27-28	Molecular symmetry	Symmetry operations, symmetry elements	Ref.1. Chp.: III 1.-2.
29-31	Rotational Spectroscopy	Classification of molecules, interaction of radiation with rotation, rigid diatomic rotator, isotope effect, non-rigid rotator, linear polyatomic molecule, symmetric & asymmetric molecules.	Ref.1. Chp.: IV 1.-9.
32-35	Infrared Spectroscopy	Vibrational motion of diatomic molecule, the vibrating diatomic rotator, asymmetry of vibration-rotational band, vibration of polyatomic molecules, vibration-rotational spectra of polyatomic molecules.	Ref.1. Chp.: V 1.-7.
36-37	Raman Spectroscopy	Theory of Raman scattering, rotational Raman spectra, Vibrational Raman spectra, mutual exclusion principle	Ref.1. Chp.: VI 1.-4.
38-40	Electronic Spectroscopy of Molecules	Vibrational coarse structure, Franck-Condon Principle, Fortrat parabolas, Dissociation, Predissociation.	Ref.1. Chp.: VII 1.-9.
41-42	Spin Resonance Spectroscopy	Principles of Nuclear magnetic resonance & electron spin resonance	Ref.2. Chp.7 7.1

Evaluation Scheme:

EC No.	***Evaluation Component***	***Duration***	***Weightage (%)***	***Date, Time & Venue***	***Remarks***
1.	Mid Sem. Exams	90 min	30	19/3 9:00 - 10:30 AM	Closed Book
2.	Tutorial tests	15 mins.	25	***	Closed Book
3.	Comprehensive Exam.	3Hrs	45	3/5 FN	Closed & Open book

Chamber Consultation Hour(s): To be announced in class.

Notices: Notices for the course will be displayed on **FD-III** notice board.

Make-up Policy: Make up will be given strictly to **genuine cases only** i.e. **(i)** Sickness leading to hospitalization, **(ii)** Out of station with prior intimation &permission.

Instructor-in-charge

PHY F432