



Second Semester 2020-2021

Date: 10 Jan 2021

Course No.: PHY F342

Course Title: Atomic and Molecular Physics

Instructor-in-Charge: Amol Holkundkar

Scope and Objective:

The aim of this course is to present a comprehensive account of the physics of atoms and molecules and the related spectroscopy. The atomic physics part will include structure of single, two and many-electron atoms, the interaction of atoms with electromagnetic radiation and elements of atomic spectra. The molecular physics part will comprise electronic structure of diatomic and polyatomic molecules within the Born-Oppenheimer approximation and elements of electronic, vibrational and rotational spectra of molecules. The course will be the students' first encounter with serious applications of quantum theory.

Text Books:

Physics of Atoms and Molecules, B.H.BRANDSEN and C.J. JOACHAIN, Second edition, Pearson Education Ltd.

Reference Books:

1. Atoms Molecules and Photons, *W Demtröder*, Springer (2010) 2/e
2. Atoms and Quanta, *Haken and Wolf*, Springer (2010) 2/e
3. Quantum Mechanics: Concepts and Applications, Nouredine Zettili, Wiley.

Course Plan:

Module	Lecture Session	Reference	Learning Outcome
1	1- 9	3.1-3.4, 4.1-4.7	Review of one electron atoms (eigenfunctions, expectation values etc.), perturbation theory, Interaction of e.m. field with charged particles, transition rates, dipole approximation, the Einstein coefficients, Selection rules, line shapes and widths
2	10-12	5.1-5.3	Fine structure of hydrogenic atoms, the Lamb shift, Hyperfine structure and isotope shifts
3	13-17	7.1-7.6	Ortho and Para states, ground and excited states of two-electron atoms, level scheme of two-electron atoms.



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4	18-25	8.1,8.4-8.5	The central field approximation, Hartree-Fock approximation, Correction to the central field approximation
5	26-34	10.1-10.6	The Born-Oppenheimer approximation, electronic structure of diatomic molecules, the rotation and vibration of diatomic molecules, the structure of polyatomic molecules
6	35-42	11.1-11.6	Rotational spectra of diatomic molecules, vibrational-rotational spectra of diatomic molecules, electronic spectra of diatomic molecules, vibrational-rotational spectra of poly-atomic molecules, Raman spectra

Evaluation Scheme:

There will be 4 tutorial tests (18 marks) and 1 take home assignment (18 marks). The take-home assignment will be given before the last tutorial test. Two tutorial tests will be before mid-term and 2 will be after. All the tutorial tests will be announced a week before.

No.	Evaluation Component	Duration	Weightage	Date & Time
1	Tutorial Tests / Assignments (Close/Open book)	30 mins	30%	TBA
2	Midterm Test (Close Book)	90 mins	30%	TBA
3	Comprehensive Examination (Close/Open book)	120 mins	40%	TBA

Notices: All the classes will be conducted in online mode with Google Meet. All notices will be uploaded on Google Classroom.





BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division

Chamber Consultation Hours: To be announced

Make-up Policy: Make-up will be given only in genuine cases, that is, illness leading to hospitalization or going out of station with prior permission. No make-ups for the tutorials.

Instructor-in-charge



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