Course Number	EP401/PH521
Course credit (L-T-P-C)	3-1-0-8
Course title	Atomic and Molecular Physics
Learning mode	Lectures and tutorials
Learning objectives	Learn about the electronic transitions and subsequent production of atomic/molecular spectra in single- and multi-electron systems.
Course content	One electron atoms , Schrodinger equation for one-electron atoms, Interaction of one electron atoms with electromagnetic radiation, Transition rates, The dipole approximation, The Einstein coefficients, Selection rules, Spectrum of one electron atoms, Line intensities and the life time of the excited states, Line shapes and widths, Fine structure and Hyperfine structure, The Lamb Shift, Zeeman and Stark effect. Many electron systems: central field approximation, Thomas Fermi model, Hartree- Fock method and the SCF, L-S coupling and j-j coupling, Introduction to the Density functional theory, Interaction of many electron atoms with electromagnetic radiation, Molecular structure, Born -Oppenheimer approximation, The rotation and vibration of diatomic molecules, Electronic structure of diatomic molecule, Rotational and Vibrational Spectra of diatomic molecules, Electronic spectra of diatomic molecules, The Franck-Condon principle.
Pre-requisites	QM-I and QM-II
Assessment method	Quiz (Q), Assignments (A), MidSem (MS), EndSem (ES). Internal (Q+A)=20%, MS=30%, ES=50% *Depending on course progression and other factors, I may or may not take quizzes.
Textbooks and references	I will mainly follow the two textbooks listed below: • B.H. Bransden and C.J. Joachain, Physics of atoms and molecules, Longman Scietific and Technical, 1983. • W. Demtroder, Atoms, Molecules and Photons, Springer, 2010. *You may find copies of both these books in library or online.

Teaching Plan (Tentative)			
Lecture topics	**Hours required**	**Semester Week**	**remarks**
Introduction + One electron atoms	2	2	First class on 31/7
Schrodinger equation for one-electron atoms	2	3	
TDPT review + Interaction of one electron atoms with electromagnetic radiation	2	3	
Transition rates	2	4	
The dipole approximation	2	4	
The Einstein coefficients	2	5	
Selection rules	2	5	
Spectrum of one electron atoms	2	6	
Line intensities and the life time of the excited states	2	6	
Line shapes and widths	2	7	
Fine structure	2	7	
Hyperfine structure + The Lamb Shift	2	8	
Zeeman and Stark effect	2	8	
Many electron systems: central field approximation	2	9	No class on 16/9 due to holiday
MIDSEM (Week 10)			
Thomas Fermi model	2	11	No class on 2/10 due to holiday
Hartree- Fock method	4	12	
L-S coupling and j-j coupling	2	13	
Introduction to the Density functional theory	2	13	
Interaction of many electron atoms with electromagnetic radiation	2	14	
Molecular structure	2	14	
Born -Oppenheimer approximation	2	15	
The rotation and vibration of diatomic molecules	2	15	
Electronic structure of diatomic molecule	2	16	On leave 6/11 – No class
Rotational and Vibrational Spectra of diatomic molecules	2	17	
Electronic spectra of diatomic molecules	2	17	
The Franck-Condon principle	2	18	
Extra hours	2	18	Spare week - 2 hours extra
TOTAL HOURS	56		