Course Number	EP302
Course credit (L-T-P-C)	3-1-0-8
Course title	Quantum Mechanics - II
Learning mode	Offline
Course content	WKB Approximation, Bohr-Sommerfeld quantization condition; Time dependent perturbation theory, interaction picture; Constant and harmonic perturbations Fermi's Golden rule; Scattering theory: Laboratory and centre of mass frames, differential and total scattering cross-sections, scattering amplitude; Born approximation, Greens functions, scattering for different kinds of potentials; Partial wave analysis; Special topics in radiation theory: semi-classical treatment of interaction of radiation with matter, Einstein's coefficients, spontaneous and stimulated emission and absorption, application to lasers; Symmetries in quantum mechanics: Conservation laws and degeneracy associated with symmetries; Continuous symmetries, space and time translations, rotations; Rotation group, Wigner-Eckart theorem; Discrete symmetries; parity and time reversal. Relativistic quantum mechanics, Klein-Gordon equation, Interpretation of negative energy states and concept of antiparticles; Dirac equation, covariant form, adjoint equation; Plane wave solution and momentum space, spinors; Spin and magnetic moment of the electron.
Pre-requisites	Quantum Mechanics I
Assessment method	Assignments (A), MidSem (MS), EndSem (ES). • Internal (A)=20%, MS=30%, ES=50%
Textbooks	I will be following the these textbooks for this course: • R. Shankar, Principles of Quantum Mechanics, Springer (India), 2008. • J. J. Sakurai, Modern Quantum Mechanics, Pearson Education, 2002. • J. J. Sakurai,Advanced Quantum Mechanics, Pearson Education, 2007.

TENTATIVE COURSE PLAN

Lecture topics	Hours required	Week	remarks
Course introduction	1	3	
WKB approximation	3*	3	Extra class – **Fri 19/1 @ 10AM**
Bohr-Sommerfeld quantization condition	1	3	
Tutorial 1: problem solving	2	4	
Time dependent perturbation theory	2	4	
Periodic perturbation and Fermi's golden rule	2	5	
Interaction picture	2	5	
Scattering theory	3	6	
Born approximation, Green's function	2	6	1h more due to Timetable adjustment 10/2
Partial wave analysis	2	7	
Overview of radiation theory: semiclassical treatment of radiation-matter interaction	2	7	Lecture rescheduling: Fri->Thu 15/2
Tutorial 2: Examples of scattering with various potentials; doubt clearance for midsem	2	8	Midsem for the rest of week
Emission, absorption and lasers	2	9	
Einstein's coefficients	1	10	Lecture rescheduling (tentative): Tue->Mon 4/3; on leave for the rest of the week
Introduction to symmetries in physics	2	11	
Symmetries in QM: conservation laws	1	11	
Degeneracy associated with symmetries	1	11	
Continuous symmetries	2	12	
Tutorial 3	2*	12	1h Extra class on Wed 20/3
Rotation group	1	12	
Wigner-Eckart theorem	3	13&14	Only 2h due to TT adjustment
Discrete symmetries – parity and time reversal	2	14	
Introduction to relativistic quantum mechanics	1	14	1h extra due to TT adjustment on 6/4
Klein-Gordon equation	2	15	
Second quantization, negative energy states and antiparticles	2	15	
Dirac equation and spinors	4	16	
Spin and magnetic moment of the electron	2	17	
Tutorial 4: problems discussions for endsem	2	17	
TOTAL HOURS	**54**		

Important points to note about this course:

- Recurring lecture rescheduling: Wed -> Fri (i.e. 2 hours on Fri instead of Wed 1h); We will have Mon-1h, Tue-1h, F-2h
- There are 15 weeks (60 hours) in this semester, which is one extra week than a standard semester. Since we are starting late, we have around 14 weeks for this course (56 hours). However, we plan to cover the syllabus in 54 hours.
- I will take leave for a week in the first week of March. Therefore, two extra lectures have been arranged to compensate as per the schedule planned above. We may arrange 2 more hours of compensatory lecture/tutorial if necessary.
- Depending on the progress in lectures, we will try to have a tutorial (doubt clearance session) atleast once in two/three weeks, where you are expected to come prepared and ask me questions/doubts.
- You may expect an assignment roughly once in two/three weeks (not more than six in total).
- No quizzes!

Additional resources:

- Mathematica – computational package commonly used to perform symbolic and numerical computation in cosmology and other fields.
- Maple – an alternative to Mathematica (I don't use it often)
- arXiv.org – Useful opensource archive where thousands of new and revised research papers are uploaded everday in almost every branch of physics, including GR and cosmology (gr-qc, hep-th, astro-ph).
- Inspirehep.net – Online archive exclusively for high energy physics community. All papers on arXiv are also available on inspirehep.net, along with citation, references, and author profiles.
    - Great for tracking researchers and their work.