Department of Physics, IIT Kanpur
PHY626 (Quantum Mechanics-II), 2025-26, Sem-II

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Teaching Assistants: Dr. Ankit Anand (anand@iitk.ac.in)
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Schedule and Venue: Tutorial: Monday, 10:00-10:50 in L09
Lectures: Tuesday, 10:30-11:45 in L14
Thursday, 12:00-13:15 in L14

Contact Hours (outside class room): For any kind of academic help, students may contact me and/or TAs through an email for fixing mutually convenient meeting time.

Communication Channel: All the information related to this course will be communicated through "**Hello IITK**" portal:
https://hello.iitk.ac.in/user/login

Objectives: The objectives of this course are the following:

(a) **Approximation methods**: Learning formalism of perturbation methods (time-indepedent and time-dependnet perturbation theory) and applying to real systems like one-electron atoms explaining the fine structure energy levels, Stark effect, Zeeman effect, Rabi transition (NMR, ESR), photoionization and many other interesting examples.

(b) **Quantum Scattering**: Learning quantum scattering formalism (Lippmann-Schwinger equation, Born approximation, partial wave analysis etc) and applying to real world problem.

(c) **Relativistic quantum mechanics**: Learning relativistic quantum mechanics (Klein-Gordon equation and Dirac equation for spin-1/2 particle) and their associated properties.

This course will help to learn various advance techniques to solve real world complex systems governed by quantum mechanics.

Outcomes: At the end of this course, students will gain fundamental knowledge, advance techniques and problem solving skills, which are necessary for higher academics as well as in industry involving quantum technology. It will also enhance student's critical & logical thinking ability, and analytical & numerical problem solving skills.

Evaluation: Four Assignments: 20 (= 4 x 5)
                        Two Quizzes: 30 (= 2 x 15)
                           Mid-sem: 80
                           End-sem: 120

                                  Total: 250

• **Passing marks:** **Minimum marks required to pass this course is 30% (i. e. 75 out of 250)**.

• **Grading:** Hybrid (Relative and Absolute)

Course Syllabus: Syllabus for this course can be found at
https://www.iitk.ac.in/phy/data/PHY-CourseBooklet-18-03-24.pdf

Mid-sem syllabus: Topics covered before mid-sem exam.

End-sem syllabus: $(20\pm\epsilon)$ marks from mid-sem syllabus and $(100 \mp\epsilon)$ marks from the topics discussed after mid-sem exam. Here ($\epsilon \leq 5$).

Course policy:

•   **Attendance:** Biometric based attendance will be recorded during lectures and tutorials. **Minimum 80% attendance** is mandatory for appearing end-sem exam. Note that lecture and tutorial attendance carry equal weight. Genuine medical cases, supported by the medical certificate(s) issued by our Institute Health Center during the present semester, will be considered separately.

• **Absent during exams:** Appearance in the end-sem exam or its make-up exam (as per Institute rules) is mandatory to pass this course. Failing to do so will automatically lead to an **F grade** irrespective of your performance   in   previous   exam   components.

• There will be no make-up quizzes/mid-sem exam. Marks for missed quizzes and/or mid-sem exam will be prorated only for genuine medical cases. You have to submit a xerox copy of relavant pages of your medical booklet issued by our Institute Health Center. At the same time, you have to show the original medical booklet for authentication.

•   **Homework problems:** Homework problem sets of different topics will be sent in a regular interval. Students are advised to work out the HW problems, but do not need to submit solutions of the HW problem sets.

•   **Assignments:** Four Assignment problem sets will be sent at suitable times, which students have to submit in **Hello IIT-K** portal before the deadline. Note that e-mail submission of Assignmments will not be accepted. Submission deadline will be extended only if there is any technical problem at the Portal.

The Assignment sets will have problems mostly picked-up from the HW problem sets. Thus working out HW problem sets regularly will help the students to submit the Assignments before deadline.

• **Copy Showing:** The graded mid-sem, end-sem and quizz copies will be shown at the appropriate time. But the re-graded copies will not be shown. Instructor will keep all the graded copies. Note that any unnecessary request for regrading will attract penalty.

• **Collaborative study:** Students are encouraged to discuss among yourselves and try to solve the HW problems, but do not copy from your friends while submitting Assignments.

• **Ethics**: We will follow a zero-tolerance policy for academic misconduct. Any academic wrondoing ((i) copying, (ii) use of unfair means in exam/quizz, (iii) impersonating, (iv) using electronic gadgets, notes, printed materials, books inside/outside exam hall, (v) submitting fake/tampered medical certificate(s) etc) will lead to **F grade**. At the same time, it will be reported to SSAC for further necessary action.

Suggested books:

(i) *Modern Quantum Mechanics* by J. J. Sakurai

(ii) *Introduction to Quantum Mechanics* by D. J. Griffithis

(iii) *Principles of Quantum Mechanics* by R. Shankar

(iv) *Quantum Physics* by S. Gasiorowicz

(v) *Quantum Mechanics, Volume 1 and 2* by Claude Cohen Tannoudji, B Diu and F laloe.

(vi) *Quantum Mechanics: Concepts and Applications* by N. Zettili

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