Quantum Physics (PHY204 / PSO201A)

Department of Physics, IIT Kanpur; Semester II, 2016-17

Instructor: Anand Kumar Jha (akjha@) Office: CL-104D; Ph: 512-259-7014(Off); 962-142-3993(M)

Tutors: Prof. Anand Jha (akjha@), Prof. Somnath Bhowmick (bsomnath@), Girish Kulkarni (girishk@), Barun Ghosh (barung@)

TA: Abhinandan Bhattarcharjee (abhib@) and Ashish Kumar (ashishkr@)

Schedule: **Lecture**: Mon & Thu 12:00-13:00 in L4;

Tutorial: Wed 12:00-13:00: T109-T112; **Section L1:-** **Section L2:-** **Section L3:-** **Section L4:-**

Office hours:

Course Website: http://home.iitk.ac.in/~akjha/PSO201A.htm

Course content: This is a first course in Quantum Physics starting with understanding some basic physical phenomena that could not be explained by classical mechanics. After discussing the formulation of Quantum Physics, we shall discuss some of its applications to modern science and engineering. Some knowledge of classical mechanics and waves is assumed. Among mathematical tools, we shall be using calculus, differential equations and complex variables. Here is the tentative list of topics that will be covered during this course. We may add/drop a few topics to/from the list:

Basic Linear Algebra. Foundations of quantum mechanics, Black body radiation, Photoelectric effect, Compton effect, de-Broglie hypothesis and its experimental verification. Time-independent and time-dependent Schrodinger equation, Born interpretation, expectation values, free-particle wavefunctions and wavepackets, uncertainty principles. Solution of stationary-state Schrodinger equation for particle in a box, particle in a finite well, reflection and transmission across a step potential, application to phenomena like alpha-decay, one-dimensional harmonic oscillator. Solution of stationary state Schrodinger equation for the ground-state of hydrogen atom, discussion of excited-state, explanation of the periodic table by introduction of electron spin and Pauli's exclusion principle, Stern Gerlach experiment, two-level systems . Free particle wave-functions and metals, Kronig-Penny model and formation of bands in one dimension. Interaction of light with matter , Einstein's phenomenological theory, lifetime of a state, Lasers. Introduction to single photon interference and to coherence. Introduction to quantum information and quantum entanglement.

Reference books: (Here are a few reference books. No particular book could be followed as a text for the entire length of the course. But we may use one of these books as a text for a given set of topics.)

1. Robert Eisberg and Robert Resnick. *Quantum physics*, *2nd edition* (John Wiley, New York, 1985).
2. R. Shankar. *Principles of quantum mechanics*, *2nd edition* (Plenum Press, New York, 1994).
3. D. J. Griffiths. *Introduction To Quantum Mechanics, 2nd edition* (Pearson Education India, 2005).
4. Feynman R, Leighton R, and Sands M. *The Feynman Lectures on Physics*, *Volume III* (Addison Wesley, MA, 1965).
5. H. C. Verma. *Quantum Physics, 2nd edition* (Surya Publications, India, 2009).

Evaluation:

15% (quizzes); 35% Mid-sem exam; 50% End-sem exam.

(There will be 12-14 homework given out at regular intervals. The exams will be of the closed-book format.)