Quantum Physics (PSO201A/PHY204)

Department of Physics, IIT Kanpur Semester II, 2020-2021

Instructor: Prof. Tarun Kanti Ghosh (tkghosh@iitk.ac.in)

Objectives and prerequisites: This first course in Quantum Physics will begin with some physical phenomena that can not be explained by classical mechanics. First we will describe formulation of quantum physics. Then we will start discussing some applications to modern science. We will be using vector calculus, differential equations, complex variables. Some basic understanding of classical mechanics and wave mechanics will be required. The tentative list of topics are given here.

Course contents: 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 principle.

Solution of stationary state Schrodinger equation for a particle in a box, particle in a finite well, reflection and transmission across a step potential, applications to phenomena like alpha-decay, Kronig-Penny model and formation of bands in one dimension, one dimensional harmonic oscillator, ground state of hydrogen atom.

Variational principle for approximate solution and simple application to obtain ground state energy of helium atom.

Introduction of electron spin and Pauli's exclusion principle, Stern-Garlach experiment, Two-level system.

Interaction of light with matter, Einstein's phenomenological theory, lifetime of a states and LASER.

Reference books:

1. R. Shankar, *Principles of Quantum Mechanics*, (Plenum Press, New York 1994)

2. D. J. Griffiths, *Introduction to Quantum Mechanics* (Pearson Education India, 2005)

3. R. P. Feynman, R. Leighton, and M. Sands, *The Feynman Lectures on Physics*, volume-III (Addison Wesley, MA, 1965)

Evaluation: to be announced later