PH301 Quantum mechanics and applications

Credit: (2.5-0.5-0-3) Approval: Approved in 2nd Senate

Prerequisites:

Students intended for: B.Tech

Elective or Core: elective Semester: Odd/Even

Course objective:

This course is an introductory level course on quantum mechanics. The course will begin with the basic principles of quantum mechanics and its conceptual formalism. Several applications of quantum mechanics will be discussed to train students to apply these ideas to model systems. Principles behind some of the exciting applications of quantum mechanics such as quantum computers, communication systems, lasers, atomic clocks will be discussed. Modern technologies explore possibilities in atomic scale (nano-technology) where quantum mehanical effects are more important. The purpose of the course is to provide a deep understanding and insight on quantum mechanics to equip them to contribute to such modern applications.

Course content:

- Review of postulates in quantum mechanics, observables and operators, theory of measurement in quantum mechanics, state of the system and expectation values, transition from quantum mechanics to classical mechanics-Ehrenfast theorem. [5 Lectures]
- Application of Schrodinger equation in 1-D: rectangular barrier, tunneling, square potential well, delta-function potential [5 Lectures]
- Basic mathematical formalism of quantum mechanics, Dirac notation, linear vector operators, matrix representation of states and operators, commutator relations in quantum mechanics, commutator and uncertainty relations, complete set of commuting observables [6 Lectures]
- Quantum computation and information: Qubits and logic gates [4 Lectures]
- Theory of angular momentum in quantum mechanics, commutator relations in angular momentum, eigen values and eigen states of angular momentum [5 Lectures]
- Application of Schrodinger equation in 3-D models, central potentials, Schrodinger equation in spherical co-ordinates, solution to hydrogen atom problem [5 Lectures]
- Time independent non-degenerate and degenerate perturbation theory, fine-structure of hydrogen, Zeeman effect and hyperfine splitting [5 Lectures]
- Time dependent perturbation theory, two level systems, emission and absorption of radiation [5 Lectures]

References:

1. Introduction to quantum mechanics-D J Griffith

2. Introductory Quantum Mechanics – R Liboff

3. Quantum physics of atoms and molecules-R Eisberg& R Resnick.

4. Quantum Mechanics for Scientists and Engineers- D A B Miller

5. Applied quantuum mechanics – Levi

6. Quantum Mechanics B. H. Bransden& C. J. Joachain

7. Modern Quantum Mechanics - J J Sakurai

8. Principles of Quantum Mechanics - R Shankar

9. Quantum Mechanics -Vol.1– Cohen-Tannoudji, B Diu, F Laloe