Quantum Mechanics and Applications - Video course

COURSE OUTLINE

Basic mathematical preliminaries:Dirac Delta function and Fourier Transforms.

Wave particle duality, one- and three- dimensional Schrödinger equation. The free particle problem in one dimension. Wave Packets and Group velocity.

One-dimensional problems: Potential well of infinite and finite depths, the linear harmonic oscillator.

Angular Momentum and rotation.

Three-dimensional Schrödinger equation: Particle in a box with applications to the free electron model. Particle in a spherically symmetric potential problem. The hydrogen atom and the deuteron.

(A numerical method to obtain solutions of the Schrödinger equation will also be discussed and a software to understand basic concepts in quantum mechanics will also be demonstrated).

Dirac's bra - ket algebra; Linear Harmonic Oscillator problem using bra - ket algebra, creation and annihilation operators, transition to the classical oscillator, Coherent states.

The angular momentum problem, using bra - ket algebra, ladder operators and angular momentum matrices. The Stern Gerlach and magnetic resonance experiments. Addition of Angular Momenta and Clebsch Gordon coefficients.

Perturbation Theory with applications; The JWKB approximation with applications; Scattering Theory: Partial Wave Analysis.

COURSE DETAIL

TOPICS	No. of Hours
Basic mathematical preliminaries: Dirac Delta function and Fourier Transforms.	**2**
Wave particle duality, one- and three-dimensional Schrödinger equation. The free particle problem in one dimension. Wave Packets and Group velocity.	**4**
One-dimensional problems: Potential well of infinite and finite depths, the linear harmonic oscillator problem.	**4**
Angular Momentum and rotation.	**3**
Three-dimensional Schrödinger equation:	**6**

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Physics

Pre-requisites:

B.Sc. Mathematics & Physics.

Additional Reading:

1. R.P. Feynman, R.B. Leighton and M. Sands, *The Feynman Lectures on Physics*, Vol. I, Addison Wesley Publishing Co., Reading, Mass (1963).
2. A Ghatak, Basic Quantum Mechanics (with CD), Macmillan.

Coordinators:

Prof. Ajoy Ghatak
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Particle in a box with applications to the free electron model. Particle in a spherically symmetric potential problem. The hydrogen atom and the deuteron. A numerical method to obtain solutions of the Schrödinger equation will also be discussed and a software to understand basic concepts in quantum mechanics will also be demonstrated.	
Dirac's bra - ket algebra; Linear Harmonic Oscillator problem using bra - ket algebra, creation and annihilation operators, transition to the classical oscillator, Coherent states. The angular momentum problem, using bra - ket algebra, ladder operators and angular momentum matrices. The Stern Gerlach and magnetic resonance experiments. Addition of Angular Momenta and Clebsch Gordon coefficients.	**9**
Perturbation Theory with applications.	**5**
The JWKB approximation with applications.	**3**
Scattering Theory: Partial Wave Analysis.	**4**

References:

1. A Ghatak and S Lokanathan, Quantum Mechanics: Theory and Applications, 5th edition, Macmillan India, New Delhi (2005).
2. PAM Dirac, The Principles of Quantum Mechanics, Oxford University press, Oxford (1958).
3. J.L.Powell and B. Craseman, Quantum Mechanics, Addison Wesley (1961).