ADVANCED QUANTUM MECHANICS WITH APPLICATIONS

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PRE-REQUISITES : Quantum Mechanics course at the undergraduate level

INTENDED AUDIENCE : UG and PG students of Electrical and Electronics Engineering/ Engineering Physics/Physics

INDUSTRIES APPLICABLE TO : R & D sectors of semiconductor, optics industries and Lab equipment manufacturing industries.

COURSE OUTLINE :

The Course deals with the prerequisite material for studying advanced level research in various fields of Physics, Applied Physics and Electrical Engineering. The course begins with an introduction to advanced topics, such as, the Density Matrix formalism and its applications to quantum optics. Hence angular momentum is introduced to discuss nuclear magnetic resonance. Hence basics of quantum information theory is brought into consideration with a view to explain quantum information algorithms. Quantum dynamics is hence studied with a view to understand quantum optics for driven systems. A glossary of the approximate methods is described with a few examples. Finally, basics of quantum transport is presented to understand the conductance properties of semiconductors.

ABOUT INSTRUCTOR :

Prof. Saurabh Basu is a professor at the Department of Physics, IIT Guwahati. The area of expertise is Theoretical Condensed Matter Physics, with special emphasis on the correlated boson and fermion systems, topological insulators. He has more 85 research publications in different refereed international journals.

COURSE PLAN :

 Week 1: Introduction to Quantum Physics, Postulates, Different representations

  Week 2: Density Matrix formalism, Harmonic Oscillator, Applications to coherent and squeezed states,

Spherically symmetric systems, Quantum dots

 Week 3: Spin angular momentum, Nuclear magnetic resonance

 Week 4: Quantum information theory, Entanglement, Shanon entropy

 Week 5: Quantum computing algorithms, EPR and Bell's paradox

 Week 6: Quantum dynamics, periodically driven systems

 Week 7: Approximation methods, perturbation theory, Variational and WKB approximation.

 Week 8: Linear response theory, Kubo formula