PPH312 ADVANCED QUANTUM MECHANICS

L	T	P	Cr
3	1	0	3.5

Course Objectives: To impart knowledge of advanced quantum mechanics for solving relevant physical problems.

Relativistic Quantum Mechanics: Klein-Gordon equation, Dirac equation and its plane wave solutions, solution of Klein Gordan equation for a particle with Coulomb potential, significance of negative energy solutions, spin angular momentum of the Dirac particle. The non-relativistic limit of Dirac equation, Dirac equation for a particle in a central field, fine structure of hydrogen atom, Lamb shift.

Field Quantization: Classical field theory, Lagrangian and Hamiltonian formalism of a particle in an electromagnetic field, Second quantization, Concepts and illustrations with Schrödinger field.

Relativistic Quantum Field Theory: Quantization of a real scalar field and its application to one meson exchange potential. Quantization of a complex scalar field, Dirac field and e.m. field, Commutation relations.

Interaction: Yukawa interaction, Coupling of electron and electromagnetic field, Global and guage invariance Feynman diagrams, Feynman rules, Feynman graphs for Compton and e-e scattering, Path integration method: Wick's Theorem. Scattering matrix.

Course learning outcomes: Students will have achieved the ability to:

1. explain the relativistic quantum mechanical equations, namely, Klein-Gordon equation and Dirac equation
2. describe second quantization and related concepts.
3. explain the formalism of relativistic quantum field theory.
4. draw and explain Feynman graphs for different interactions

Recommended Books:

1. *Mathews, P.M. and Venkatesan K.A., Textbook of Quantum Mechanics, Tata McGraw Hill (2004).*
2. *Thankappan, V.K., Quantum Mechanics, New Age International (2004).*
3. *Sakurai, J.J., Advanced Quantum Mechanics, Pearson Education (2007).*
4. *Bethe, H.A. and Jackiew, R., Intermediate Quantum Mechanics, Perseus Book Group (1997).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25