

# Phys 761

## Graduate Quantum Mechanics

### Fall 2016

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*The Hashemite University Department of Physics, Zarqa, Jordan*

September 17, 2016

**Lectures:** Sunday and Tuesday 2:00 - 3:30 Pm, Physics Building, Room # 121

**Office hours:** Sunday and Tuesday 1:00 - 2:00 Pm and Monday and Wednesday 11:30 - 12:30 Pm or by appointment, office location: physics Building Room # 107

**Email:** Gassem@hu.edu.jo

**Textbook:** Nouredine Zettili, Quantum Mechanics Concepts and Applications, Second edition

**course webpage:** Lecture notes and homework problems will be posted at *staff.hu.edu.jo/gassem*

**Grading:** To be announced latter

#### Topics to be covered (tentative):

1. **Three-dimensional motion:** 3D problems in spherical coordinates, central potential, the free particle in spherical coordinates (the spherical Bessel equation and its solutions in terms of Bessel and Neumann functions), the spherical square well(introducing Hankel's functions) , the isotropic harmonic oscillator, the Hydrogen atom (reduction of a two-body problem, the radial equation and its solution, the energy spectrum)
2. **Rotations and addition of angular momenta:** rotations in quantum mechanics, generators of rotation , infinitesimal rotations, finite rotations, algebra of angular momentum, spin 1/2 Pauli theory, Clebsch Gordan Coefficients, construction of an arbitrary spin state, addition of angular momenta, coupling of orbital and spin angular momenta, addition of more than two angular momenta
3. **Scattering theory:** scattering and cross section, scattering amplitude, potential scattering and Born approximation, low-energy and high-energy scattering, partial wave analysis for elastic scattering
4. **Time-independent perturbation theory:** non-degenerate and degenerate perturbations, the stark effect in the Hydrogen atom, vector model, fine structure (relativistic corrections and spin-orbit coupling), normal and anomalous Zeeman effects
5. **Variational methods:** examples and application about estimation the ground state energy of several systems
6. **Time-dependent perturbation theory:** transition probability, sudden perturbation, adiabatic perturbation, harmonic perturbation, Fermi's Golden rule

*Good Luck*