OSE6349: Applied Quantum Mechanics for Optics and Engineering (Fall 2021)

Grading

50% homework

25% midterm

25% final

Suggested textbooks

H. Kroemer, “Applied quantum mechanics for engineering, materials science, and applied physics,” (Prentice Hall, New Jersey, 1994).

R. Gilmore, “Quantum mechanics in one dimension,” (The Johns Hopkins University Press, 2004).

D. A. B. Miller, “Quantum mechanics for scientists and engineers,” (Cambridge University Press, 2008).

Bibliography:

There are of course a very large number of introductory textbooks on quantum mechanics. There is no single agreed upon textbook for applied quantum mechanics geared towards the student of optics. Here are some suggestions (other suggestions will be provided as we go along):

Chris Isham, “Lectures on quantum theory: Mathematical and structural foundations”; A. Messiah, “Quantum mechanics”; Paul M. A. Dirac, “The Principles of Quantum Mechanics”; The Feynman Lectures on Physics, Volume III; J. J. Sakurai, “Modern Quantum Mechanics”; David Bohm, “Quantum theory”; Peter Atkins, “Physical Chemistry” and “Molecular Quantum Mechanics”.

The students will also be provided with course notes prepared by the instructor.

<u>Week 1:</u>

Lecture 1: Introduction; **Lecture 2:** 2D linear vector spaces

<u>Week 2:</u>

Lecture 1: Quantum mechanics using 2×2 matrices I; **Lecture 2:** Quantum mechanics using 2×2 matrices II

<u>Week 3:</u>

Lecture 1: General linear vector spaces I; **Lecture 2:** General linear vector spaces II

<u>Week 4:</u>

Lecture 1: Axioms of quantum mechanics I; **Lecture 2:** Axioms of quantum mechanics II

<u>Week 5:</u>

Lecture 1: Infinite quantum wells, density of states I; **Lecture 2:** Infinite quantum wells, density of states II

<u>Week 6:</u>

Lecture 1: The quantum harmonic oscillator I; **Lecture 2:** The quantum harmonic oscillator II

<u>Week 7:</u>

Lecture 1: Quantum mechanics in 1D I: General formalism, scattering states from a barrier, and bound states in a finite quantum well

Lecture 2: Quantum mechanics in 1D II: Multiple barriers, coupled quantum wells, and degenerate perturbation theory

<u>Week 8:</u>

Lecture 1: Quantum Mechanics in 1D III: Defect states, non-degenerate perturbation theory

Lecture 2: Quantum Mechanics in 1D IV: Linearly varying potentials, Variational principle

<u>Week 9:</u>

Lecture 1: Quantum Mechanics in 1D V: Periodic potentials

Lecture 2: Quantum Mechanics in 1D VI: Periodic potentials, perturbation theory

<u>Week 10:</u>

Lecture 1: Rotational motion and angular momentum

Lecture 2: Hydrogen and hydrogen-like atoms, the periodic table

<u>Week 11:</u>

Lecture 1: Time-dependent perturbation theory I; **Lecture 2:** Time-dependent perturbation theory II

<u>Week 12:</u>

Lecture 1: Hydrogen molecule I; **Lecture 2**: Hydrogen molecule II

<u>Week 13:</u>

Lecture 1: Applications I; **Lecture 2:** Applications II

<u>Week 14:</u>

Lecture 1: Applications III; **Lecture 2:** Applications IV

<u>Week 15:</u>

Lecture 1: Applications V; **Lecture 2:** Applications VI