OSE6347: Quantum (Spring 2026)

Grading

20% midterm

30% final

50% homework

Suggested textbooks

M. O. Scully and M. S. Zubairy, “Quantum Optics”

P. Lambropoulos and D. Petrosyan, “Fundamentals of Quantum Optics and Quantum Information”

W. H. Louisell, “Quantum Statistical Properties of Radiation”

Week 1:

Introduction; review of quantum mechanics

Week 2:

Quantization harmonic oscillator

Week 3:

Quantization of the electromagnetic field (operators, states, detection)

Week 4:

One-photon states, qubits, single-photon interferometry, pure and mixed states, quantum-state reconstruction

Week 5:

BB84 quantum key distribution, no-cloning theorem, optimal cloning

Two-photon states, a pair of qubits, pure and mixed states, correlation functions

Week 6:

Two-photon interferometry, the partial trace, quantum entanglement

Week 7:

Einstein-Podolsky-Rosen (EPR) paradox, Bell’s inequality, Clauser-Horne-Shimony-Holt (CHSH) inequality

Week 8:

Spontaneous parametric downconversion as a source of entangled photons

Week 9:

Quantum information processing: quantum teleportation, quantum dense coding, two-photon quantum state tomography

Week 10:

Quantum information processing: Bell-state analysis, quantum computing with linear optics, Greenberger-Horne-Zeilinger (GHZ) states

Week 11:

Two-level atom in a classical field, three-level atom in a classical field (pure states)

Week 12:

Index of refraction, Two-level atom in a classical field, three-level atom in a classical field (mixed states)

Week 13:

Optical nonlinearities, electromagnetic induced transparency, lasing without inversion

Week 14:

Quantum cavity electrodynamics, Jaynes Cummings model, Purcell effect

Week 15:

Coherent states and squeezed light