

# ECE 723 - Quantum Electromagnetics\*

Department of Electrical and Computer Engineering  
University of Massachusetts Amherst

Spring 2007

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**Day & Time:** Tuesday and Thursday, 11:15-12:30  
**Place:** Room 1234, Lederle Graduate Research Tower  
**Instructor:** Professor Neal G. Anderson (201B Marcus, anderson@ecs.umass.edu)  
**Prerequisite:** Classical EM theory (Maxwell's equations, vector potentials, etc.); some background in quantum mechanics helpful (e.g. ECE 607).

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## About This Course

This is a course on the quantum theory of the electromagnetic field for ECE's. Fundamental principles of the theory will be emphasized, as they provide a common foundation for a broad range of engineering applications involving electromagnetic radiation at frequencies from the terahertz through the optical. The theory will be applied to describing the light-matter interaction, light propagation through media, the laser, and other topics of interest to ECE's.

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## Topical Outline (Tentative)

1. Particle Mechanics and EM Field Theory: Common Classical Foundations
  2. Canonical Quantization
  3. Quantum Theory of the Electromagnetic Field
  4. Quantum States of Free Electromagnetic Fields
  5. Noise
  6. Electron-Photon Interactions and Optical Properties of Matter
  7. The Laser and Other Contemporary Applications
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## Resources

The course will be based primarily on class notes and handouts. A list of additional resources will be distributed and updated as the semester progresses.

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<b>Grading:</b>	Homework	30%
	Midterm Exam	35%
	Final Exam	35%

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\* Formally "Introduction to Lasers and Masers"

