678 PHYS

OPTICAL PROPERTIES OF SOLIDS

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First semester 1437-1438 H (2016-2017 J)

Course aims and outcomes

• Understand the classical theory of light propagation in solid state dielectric materials;
• Understand the quantum theory of absorption and emission in solids;
• Appreciate the importance of excitonic effects in solids;
• Understand the origin of nonlinear optical effects in crystals.

The outcome of the course will be that the student will be familiarised with the optical phenomena that occur in a wide range of solid state materials, based on an understanding of both the classical and quantum theories of how light interacts with dielectric materials.

Course syllabus

Lecture(1 hour)	Topic
1-4	**Introduction** Optical coefficient, complex dielectric constant, complex refractive index, introduction to optical materials
5-9	**Classical propagation** Propagation of light in a dense optical media(atomic oscillators, vibrational oscillators, free electron oscillator), Dipole oscillator (Lorentz oscillator, multiple oscillator, Kramers-Kroning relationships), dispersion, birefringence
10-14	**Interband absorption** interband transition, band edge absorption in direct gap semiconductors, band edge absorption in indirect gap semiconductors, interband absorption above the band edge, semiconductors photodetectors (photodiodes, photovoltaic)
15-17	**Excitons** The concept of excitons, free excitons, free excitons in external fields
18-21	**Luminescence** Light emission in solids, interband luminescence, photoluminescence, electro luminescence
22-26	**Semiconductor quantum wells** Quantum confined structure, growth and structure of semiconductor quantum wells, infinite quantum wells, finite quantum wells, quantum confines Stark effect, optical emission, interbank transition, quantum dotes
27-30	**Free electrons** Plasma conductivity, free carrier conductivity, metal, doped semiconductors, plasmons
31-33	**Phonons**
34-36	**Nonlinear optics**

Textbook:

Optical properties of solids, Mrak Fox

Optical properties of solids, Frederick Wooten

Introduction to solid state physics, Kittel

Solid state physics, Ibach and Luth

Assessment:

First Midterm 12%

Second Midterm 12%

Homework 6%

Lab 30% (15% report+15% final)

Final exam 40%