OPTI 534- Advanced Topics in Electronic Materials

Course Description:

Topics to be selected from ferroelectrics, optoelectronics, wave guides, and semiconductor materials.

Textbooks:

- Simmons and Potter, Optical Materials, Academic Press, 2000.
- Notes

Recommended

- Principles of Optics, M. Born and E. Wolf, Oxford: Pergamon Press (1980)
- Optics, E. Hecht, Addison-Wesley (1990).

Grading Policy:

- Homework - 33%
- Midterm – 33%
- Final Exam – 34%

Full credit will be given for homework that is turned in on the day it is due. Late homework will receive partial credit. No credit will be given for homework received after the homework solutions are reviewed in class.

Make-up exams will only be offered in cases where the student has an approved, documented absence (see university policy). In addition, the student MUST inform the professor of the absence and the reason for it no later than the day of the exam (email and phone message are acceptable).

Working on assigned homeworks in group settings is permitted and may, in fact, be beneficial in that students may have the opportunity to increase their depth of understanding of course topics through interactions with their peers. However, all work on exams must be a student's own. Per Univeristy of Arizona Code of Academic Integrity, "The guiding principle of academic integrity is that a student's submitted work must be the student's own." Cheating on exams will not be tolerated, sanctions will be applied per the guidelines addressed in the Student Code of Conduct.

Objectives:

To classify optical properties and electrical properties of materials according to material type, structure and physical properties. To examine recent innovation in optical and electronic materials research.

Topics:

Band structure and its relation to electrical and optical properties of materials, metals, insulators, thin films, semiconductors, gain and cavities, lasers, non-linear and electro-optic properties. Special topics anticipated to include: nano-materials, photonic band-gap structures, transparent conductive oxides, optical materials for lithography, femtosecond laser-matter interactions, photosensitive materials, optical MEMS, and solar energy systems.

Outline:

Chapter 1: Introduction to Waves and Wave Propagation

- Waves
- Electromagnetic Spectrum
- Wave Propagation
- Dispersion and Material Polarizability
- Kramers-Kronig relations
- Phonons
- Measurement Techniques

Chapter 2: Conductors

- Drude Model
- Band Structure
- Coloration
- Measurement Techniques

Chapter 3: Insulators

- Harmonic Oscillator
- Refractive Index and Dispersion
- Reflection and Transmission
- Attenuation
- Scattering
- Measurement Techniques

Chapter 4: Thin Films

Chapter 5: Semiconductors

- Free-electron Models
- Band Structure
- Impurities
- Optical Response
- Measurement Techniques

Midterm Exam

Chapter 6: Lasers

- Review of Laser operation
- Spontaneous Emission, basic cavity design, population inversion
- Examples of Lasers
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Chapter 7: Principles of Non-linear Optics

Selected Special Topics:

- Photosensitive Processes and Materials
- Optical Polymers
- Photolithography
- Micro Electro Mechanical Systems (MEMS)
- Optical MEMS
- Transparent Conductive Oxides
- Rare-Earth Materials
- Solar-Energy Systems

Final Exam