SYLLABUS: ECE 5194.10: Infrared Detectors and Systems

Spring 2017

Description: This course will cover the basics of infrared photodetectors and systems. It will include basic geometrical optics, radiometry, figures of merit and types of infrared detectors. Units: 3 credit hours. Prerequisite: ECE 3030

Lecture Hours: TBD

Learning Goals:
1) Understand the fundamentals of an infrared detector including figures of merit
2) Analyze radiation transfer from an infrared source to a detector through an optical system and know the various radiometric quantities
3) Know the operation of thermal detectors, classical and advanced photon detectors
4) Comprehend the performance of single pixel and small format arrays for a variety of applications
5) Communicate the concepts that you have learnt in a written and oral presentation.
6) Work together in a team and evaluate/assess your individual performance and the performance of your teammates

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Office Hours: Wed: 2PM-3PM and Thu: 9AM-10AM, Caldwell 377

Textbook and Reference Material:
• Class Notes, Handouts and Discussion
Course Syllabus

Module 1: Infrared Detector and Radiation Transfer
- **Chapter 1: Geometrical Optics** (Imaging concepts, Aperture stops and pupils, Field of view and Image Quality)
- **Chapter 2: Radiometry** (radiometric quantities, blackbody radiation, emissivity, incremental limit equation, spectral/spatial/time dependent integration, special cases of radiation transfer)

Module 2: Detection Processes
- **Chapter 3: Basics of Infrared Detection** (Photon detection mechanisms, Thermal detection mechanism)
- **Chapter 5: Noise in Infrared Detection** (Photon noise, Johnson Noise, Shot noise, Generation Recombination Noise)
- **Chapter 6: Figures of Merit for Infrared Detectors** (responsivity, noise equivalent power, detectivity, photon-noise limited performance, Johnson noise limited performance)

Module 3: Types of Infrared Detectors
- **Chapter 7: Photovoltaic Detectors** (PN diodes, PIN diodes, Silicon, Germanium, InSb, GaAs, Mercury Cadmium Telluride)
- **Chapter 8: Photoconductive Detectors** (Analysis of photoconductive gain, temporal response, intrinsic and extrinsic detectors)
- **Chapter 9: Thermal detectors** (theoretical performance of thermal detectors, responsivity and noise, bolometers, pyroelectric detectors)
- **Chapter 11: Band-engineered detectors** (Quantum well and Quantum Dot infrared photodetectors, Type II superlattice detectors, Unipolar barrier detectors)

Grading:

- Midterm 1 25%
- Midterm 2 25%
- Final Exam 30%
- Homework 20%

Policy on Late Homeworks: Homework is due at the beginning of class on the date shown. No late work will be accepted without prior arrangement. Late work (with arrangements) will be docked 10% per day.

Working together: Students are encouraged to work together on homework but each student should hand in his or her individual solution.
**In Class Problems and Groupwork:** I will be doing in class problems and I would like to have you divided into smaller groups of 4-5 students.

**Exams:** Exams are closed book. You will be allowed a single cheat sheet, 8.5” by 11”, with handwritten notes only, on one side only. Scientific/graphic calculators are allowed. No internet-enabled devices are permitted. No cooperation on the examination is allowed. I am required to report any academic misconduct to the Committee on Academic Misconduct (COAM).

**Missed exams:** Any missed exam will result in a zero grade unless arrangements are made in advance. Suitable circumstances include illness, death in the immediate family, and situations of comparable gravity. In such cases, *if and only if arrangements are made in advance*, a make-up exam can be arranged. Midterms dates are announced will in advance, so plan your job interviews and such around them.

**Office hours:** TBD

**Reaching me:** You may reach me during office hours, or make an appointment by email if you cannot make my office hours.

**FINAL EXAM:**
TBD

**Disabilities Statement**
Any student who feels s/he may need an accommodation based on the impact of a disability should contact the instructor privately to discuss specific needs. Please contact the OSU Office for Disability Services for assistance in verifying the need for accommodations and developing accommodation strategies.

**Academic Misconduct Statement**
Any student found to have engaged in academic misconduct, as set forth in the Code of Student Conduct Section 3335-23-04, Prohibited Conduct, will be subject to disciplinary action by the university. Academic misconduct is any activity that tends to compromise the academic integrity of the university, or subvert the educational process.

**Student Conduct**
Students are expected to abide by the provisions in the Code of Student Conduct. The University’s [Code of Student Conduct](#) and [Sexual Harassment Policy](#) are available on the OSU Web page.