ECE 6533: Infrared Detectors and Systems

Course 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.

Prior Course Number: 5194.10
Transcript Abbreviation: IR Detectors
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Graduate
Student Ranks: Junior, Senior, Masters, Doctoral
Course Offerings: Autumn
Flex Scheduled Course: Never
Course Frequency: Even Years
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Lec
Expected out-of-class hours per week: 6.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 5530 or permission of instructor.
Exclusions: Not open to students with credit for 5194.10.
Cross-Listings:

Course Rationale: Prof. Krishna is setting up an infrared detector research program at OSU. This course will

enable students to learn the fundamentals of IR detectors

The course is required for this unit's degrees, majors, and/or minors: No
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Doctoral Course

Programs

Abbreviation	Description
CpE	Computer Engineering
EE	Electrical Engineering

Course Goals

Be exposed to the fundamentals of an infrared detector including figures of merit
Be familiar with radiation transfer from an infrared source to a detector through an optical system and know the various radiometric quantities
Be familiar with the operation of thermal detectors, classical and advanced photon detectors

Be familiar with performance of single pixel and small format arrays for a variety of applications
Be able to communicate the concepts that you have learnt in a written and oral presentation.
Be exposed to working in a team and evaluate/assess your individual performance and the performance of your teammates

Course Topics

Topic	Lec	Rec	Lab	Cli	IS	Sem	FE	Wor
Geometrical Optics (Imaging concepts, Aperture stops and pupils, Field of view and Image Quality)	3.0							
Radiometry (radiometric quantities, blackbody radiation, emissivity, incremental limit equation, spectral/spatial/time dependent integration, special cases of radiation transfer)	5.0							
Basics of Infrared Detection (Photon detection mechanisms, Thermal detection mechanism)	4.0							
Noise in Infrared Detection (Photon noise, Johnson Noise, Shot noise, Generation Recombination Noise)	6.0							
Figures of Merit for Infrared Detectors (responsivity, noise equivalent power, detectivity, photon-noise limited performance, Johnson noise limited performance)	4.0							
Photovoltaic Detectors (PN diodes, PIN diodes, Silicon, Germanium, InSb, GaAs, Mercury Cadmium Telluride)	4.0							
Photoconductive Detectors (Analysis of photoconductive gain, temporal response, intrinsic and extrinsic detectors)	4.0							
Thermal detectors (theoretical performance of thermal detectors, responsivity and noise, bolometers, pyroelectric detectors)	4.0							
Band-engineered detectors (Quantum well and Quantum Dot infrared photodetectors, Type II superlattice detectors, Unipolar barrier detectors)	4.0							

Representative Assignments

Homework
Midterm Exam
Final Exam

Grades

Aspect	Percent
Homeworks	20%
2 Mid Term	50%
Final Exam	30%

Representative Textbooks and Other Course Materials

Title	Author
Infrared Detectors and Systems , ISBN: 978-0-471-12209-8	E.L. Dereniak and G.D. Boreman

ABET-EAC Criterion 3 Outcomes

Course Contribution		College Outcome
*	a	An ability to apply knowledge of mathematics, science, and engineering.
	b	An ability to design and conduct experiments, as well as to analyze and interpret data.
	c	An ability to design a system, component, or process to meet desired needs.
*	d	An ability to function on multi-disciplinary teams.
	e	An ability to identify, formulate, and solve engineering problems.
	f	An understanding of professional and ethical responsibility.
*	g	An ability to communicate effectively.
	h	The broad education necessary to understand the impact of engineering solutions in a global and societal context.
	i	A recognition of the need for, and an ability to engage in life-long learning.
	j	A knowledge of contemporary issues.
*	k	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Additional Notes or Comments

After offering this as a group studies, I decided to offer it at a 6000 level and make 5530 as a pre-requisite. This will enable me to teach more advanced concepts in the class.

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