Special Topics: OSE 6938X

Infrared Detectors

College of Optics and Photonics, University of Central Florida

COURSE SYLLABUS

Instructor:	David Shelton	Term:	Summer 2019
Office:		Class Meeting Days:	Thursdays
Phone:	407-920-4844	Class Meeting Hours:	5-8:50pm
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Website:		Office Hours:	

I. Welcome!

I hope you enjoy this course as much as I have enjoyed working in the area.

II. University Course Catalog Description

This class will review appropriate background including mathematics, radiometry, and solid-state physics necessary for the design of infrared detectors. Major types of infrared detectors that will be covered include thermal, photoconductors, photovoltaic, and photodiodes. Modern starring-infrared-focal-plane design will be emphasized. Design and measurement of detector properties that contribute to detector sensitivity will be considered.

III. Course Overview

This course is presented in three sections. The first section will cover optical detection fundamentals and includes many topics that are not exclusive to infrared detection. This will include a review of some concepts from geometrical optics, radiometric calculations, probability and statistics for optical detection, and the develop of figures of merit for sensitivity which are used across the infrared systems industry. Optical detection mechanisms will be discussed, and the use of these detection mechanisms in infrared systems will be developed. In the second section, the design of infrared detectors based on critical material systems will be presented. Detector material systems to be considered include: mercury-cadmium-telluride, III-V compound strained-layer-superlattices, lead-salts, and vanadium-oxide. Solid-state physics required for detector design will be reviewed and design examples for detectors from the major material systems will be analyzed to enable modeling of detector sensitivity. Operating conditions for infrared detectors will be discussed. Finally the third section will cover an overview of practical tools and methods used to design, fabricate, and test infrared detectors. Topics closely related to starring infrared-focal-plane arrays will also be covered.

IV. Course Objectives and Outcomes

This is a graduate level course. The course is intended to provide a practical understanding of infrared detectors for those working with electro-optical sensors in the defense, security, industrial inspection, medical imaging, and similar industries. At the end of the course students will be expected to demonstrate proficiency in calculating the sensitivity, response rates, and other key performance factors for infrared detectors under a variety of operating conditions. Students will then be expected to select the proper detector and operating conditions for a given task while considering both performance and other issues such as cost, size, weight, power consumption, reliability, and technical risk.

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V. Course Prerequisites

It is expected that the student will have math background through calculus 2, a general working knowledge of electro-optical sensors, and an undergraduate level understanding of solid-state physics consistent with most electrical-engineering and

physics programs. A review of these topics will be provided as relevant to course material. No formal prerequisite course is required.

VI. Course Credits

3 (3,0)

VII. Required Texts and Materials

Infrared Detectors and Systems – E.L. Dereniak, G.D. Boreman
Fundamentals of Infrared Detector Materials -- Kinch
I will provide other papers and excerpts.

VIII. Topics Covered

• Introduction	May 16
• Starring IR Focal Plane Arrays	May 16
• Radiometry	May 16
• Optical Detection Mechanisms	May 23
• Probability and Statistics	May 23
• Noise	May 30
• Figures of Merit	May 30
• Photovoltaics	June 6
• Photodiodes	June 6
• Photoconductors	June 13
• Thermal Detectors	June 13
• Microbolometers	June 13
• ***Exam 1***	***June 20***
• Solid State Physics Review	June 27
• Lead-Salt Detectors	June 27
• III-V Alloys	June 27
• July 4th, no class	July 4
• Mercury Cadmium Telluride	July 11
• SLS Detectors	July 18
• Barrier Layer Detectors	July 18
• ***Exam 2***	***July 25***
• Infrared Detector Fabrication	Aug 1
• Infrared Detector Testing	Aug 1
• Readout Integrated Circuit Architectures	Aug 1
• Advanced Topics	Aug 1
• ***Final Exam***	***Aug 8***

IX. Basis for Final Grade

Assessment	Percent of Final Grade
Exam 1: In Class Open Book / notes	20%
Exam 2: In Class Open Book / notes	20%
Exam 3: Final Exam Open Book / notes	40%
Homework	20%
	100%

Grading Scale (%)	
94-100	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
74-76	C
70-73	C-
67-69	D+
64-66	D
60-63	D-
0 – 59	F

X. Grade Dissemination

Graded tests and materials in this course will be returned individually only by request. You can access your scores at any time using "myUCF Grades" in the portal. Please note that scores returned mid-semester are unofficial grades. If you need help accessing myUCF Grades, see the online tutorial: https://myucfgrades.ucf.edu/help/.

XI. Course Policies: Grades

Late Work Policy:

There are no make-ups for in-class tests, or the final exam. Arrangements due to conflicts need to be worked out with me prior to the test(s) and will likely occur on campus. Take home assignments will be assigned with plenty of time to complete, and will not be accepted late.

Extra Credit Policy:
Generally, there is no extra credit.

Grades of "Incomplete":
The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course and the remaining work can be completed the next semester. Your instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished by the end of the subsequent semester or the "I" will automatically be recorded as an "F" on your transcript.

Rewrite Policy:
Rewrites do not apply.

XII. Course Policies: Technology and Media

Email: Majority of interaction is expected during and after class. Email will be used on any issues related to participation.

Webcourses: Not used in this course.

Laptop Usage: Laptops are not allowed in class.

Classroom Devices: Cell phone and electronic devices must be turned off during class.