Special Topics: OSE 6938

Infrared Systems

College of Optics and Photonics, University of Central Florida

COURSE SYLLABUS

Instructor:	Ron Driggers	Term:	Spring 2018
Office:	CREOL A315	Class Meeting Days:	Tuesdays
Phone:	407-305-2577	Class Meeting Hours:	5-8pm
E-Mail:	ron.driggers@creol.ucf.edu	Class Location:	Lockheed Sand Lake Campus
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 cover appropriate background including mathematics, radiometry, and diffraction followed by imaging components to include sources, atmospherics, optics, detectors, electronics, and human vision. Then, all of the components are combined to provide system resolution, sensitivity, and visual acuity. System visual acuity is used to determine the range at which objects can be discriminated.

III. Course Overview

This course is presented in three sections. The first section provides the basic mathematics, radiometry, and diffraction theory needed to be successful in imaging system performance calculations. The second section includes a detailed look at all the components that make up an electro-optical or infrared imaging system to include sources of light, emittance, reflectance, etc. Then, atmospherics are presented to include both transmission, turbulence, scattering, and path radiance. The component associated with optics includes both diffraction and aberrations for blur and transmission for light reduction. The section on detectors covers photon detectors and thermal detectors to include responsivity, detectivity, and spatial resolution and sampling. The section on electronics provides characteristics for scanned systems as well as staring arrays and readout integrated circuits (ROICs). Finally, the section on human vision is presented in an engineering sense with contrast threshold function (CTF) of the eye as an important system parameter. All of the components are combined in system performance calculations to include sensitivity and resolution followed by system contrast threshold function (CTF). The CTF is used to calculate object discrimination at range. These concept apply to both infrared and electro-optical imaging system performance.

IV. Course Objectives and Outcomes

This is a graduate level course. Students will be expected to be experts in radiometry and know how to convert quantities quickly (e.g., radiance to intensity). At the end of this course, students will be expected to analyze an existing electro-optical or infrared imager as well as design an electro-optical or infrared imager. Students will be required to calculate all component level performance metrics (e.g., detector angular subtense, optical modulation transfer function, human visual contrast threshold function, etc.) More importantly, students will be required to quickly determine whether an imager is diffraction-limited, detector-limited, sampling-limited, turbulence-limited, etc. Students will be required to design an infrared imager that can identify human activities at 10 kilometers range under given conditions. Students will be required to analyze a given infrared imager and make improvements to the system performance.

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V. Course Prerequisites

Students need to have an excellent math background through calculus 2 and at least be proficient in functions, convolution, correlation, and Fourier Transforms. A short review will be provided, but the course will be difficult without an excellent understanding of these concepts. I strongly suggest a review of these areas prior to taking the course.

VI. Course Credits

3 (3,0)

VII. Required Texts and Materials

Introduction to Infrared and Electro-optical Systems (Second Edition) – Driggers, Freidman, Nichols
I will provide all other papers

VIII. Topics Covered

- Introduction Jan 9
- Mathematics Jan 9
- Linear Shift Invariant Systems Jan 16
- Diffraction Jan 16
- Sources of Radiation Jan 23
- Atmospherics Jan 30 (Test 1 First)
- Optics Feb 6
- Detectors Feb 13
- Electronics Feb 20
- Image Processing Feb 20
- Displays and Human Perception Feb 27
- MTF and NETD Mar 6, (Test 2 First)
- Historical Performance Models Mar (13 and 20th…substitute) Hand out analysis/design
- Contrast Threshold Function and the Target Task Performance Metric Mar 27
- Electro-Optical and Infrared System Performance Apr 3
- Laboratory Measurements of Infrared Systems Apr 10
- NVTherm Tutorial Apr 17 (Hand in Analysis/Design test)
- Final Exam Apr 24/25 (Sign up previously)

IX. Basis for Final Grade

Assessment	Percent of Final Grade
Exam 1: In Class Closed Book	25%
Exam 2: In Class Open Book	25%
Exam 3: Final Exam Oral	25%
System Analysis/System Design Project	25%
	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 oral 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.