OPTI 613 – Introduction to Infrared Systems  
Spring 2021

(As you fill in this document, please replace the black text with your own policies and try to maintain the headings to make it easier for students to locate information in all of their courses. For more details regarding the graduate syllabus policy see https://policy.arizona.edu/faculty-affairs-and-academics/course-syllabus-policy-graduate )

Semester and Year this Document Covers  
Spring 2021

Course Meeting Information:  
Tuesday & Thursday  
3:30 – 4:45 pm  
Meinel, 305

Course Number and Title  
OPTI 613 Introduction to Infrared Systems

Course Description

This course provides the background, theory, and practice of how to design, analyze, and test high performance infrared imaging systems. The course is presented in three sections. The first section provides a brief review of 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 targets, atmospheres, optics, detectors, electronics, signal and image processing, displays and the human visual system. The student is taught how to calculate the component resolution (modulation transfer function) and sensitivity for each of the components. Modulation Transfer Functions and optical throughput along with signal-to-noise is determined for each imaging system component. The student is taught how to determine whether a system is turbulence-limited, detector-limited, diffraction or aberration-limited, display-limited, or human vision system limited. The third section teaches the student how to combine all the component transfer functions and throughput (with infrared radiation) to determine the imaging system contrast threshold function. This system CTF is used in the design of imaging systems to accomplish some object discrimination task (e.g., detection, recognition, or identification). System theory, laboratory performance, and field performance are covered. These concepts apply to both infrared and electro-optical imaging system performance.

Instructor Information

Instructor Name: Ronald Driggers  
Title: Professor

Contact Information: College of Optical Sciences  
Office 437  
Meinel Bldg  
1630 E University Blvd, Tucson, AZ 85721  
Phone: TBD  
Email: rdriggers@optics.arizona.edu  
Office Hours: Tu, Thu 0900-1100

Learning Outcomes

This is a graduate level course. After this course:

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

Pre-Requisites

Prerequisite of background in Fourier Transforms, Linear Systems, OPTI 512R or equivalent recommended. OPTI 505R Diffraction and Interferometry would be beneficial but not required.

Required Texts and Materials
Schedule of Topics and Activities

• Introduction
• Mathematics Review
• Linear Shift Invariant Systems Review
• Diffraction Review
• Sources of Radiation
• In-Class Closed Book Test
• Atmospherics
• Optics
• Detectors
• Electronics
• Image Processing
• Displays and Human Perception
• In-Class Open Book Exam
• MTF and NETD
• Historical Performance Models
• CTF and the Target Task Performance Metric
• Electro-Optical and Infrared System Performance
• Laboratory Measurements of Infrared Systems
• NVTherm Tutorial
• Final Exam

Assessments

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Percent of Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1: In Class Closed Book</td>
<td>25%</td>
</tr>
<tr>
<td>Exam 2: In Class Open Book</td>
<td>25%</td>
</tr>
<tr>
<td>Exam 3: Take Home Analysis or Design Problem</td>
<td>25%</td>
</tr>
<tr>
<td>Exam 4: Oral Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Total Grade</td>
<td>100%</td>
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</tbody>
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Grading Scale and Policies

Grading Scale (%)  
90-100 A
80-89 B
70-79 C
60-69 D
0-59 E

Late Work Policy:
There are no make-ups for class tests, or the final oral exam. Arrangements due to conflicts need to be worked out with me prior to the test(s). 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.

University Policies

All university policies related to a syllabus are available at: https://academicaffairs.arizona.edu/syllabus-policies. By placing this link in your syllabus, you no longer need to have each individual policy included in your syllabus.

Subject To Change Notice

Information contained in the course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor of this course.

 Graduate Student Resources (optional)

Please consider including a link to the University of Arizona's Basic Needs Resources page: http://basicneeds.arizona.edu/index.html