Regardless of course type; e.g., traditional, media-enhanced, or Web, syllabi at UCF are required to include:

- **Course title and number**
- **Credit hours**
- **Name(s) of instructor(s)**
- **Office location**
- **Office or Web hours**
- **Course goals**
- **Course description**
- **Course requirements**
- **Methods of evaluation; grading system, including plus and minus grade policy, how grades will be posted**
- **Makeup exam policy**
- **Required and optional texts**
- **Final exam date and time**
- **Financial Aid Statement**
- **Other required course material**

PRIOR TO PRINTING, DELETE THIS LINE AND ABOVE
ALTER THE SYLLABUS BELOW TO YOUR LIKING

UCF CREOL, THE COLLEGE OF OPTICS AND PHOTONICS

Course Syllabus

OSE4830 Imaging and Display, 3 credits

Instructor: Shuo Pang
Email: pang@creol.ucf.edu
Phone: 4078236869
Office: CROL A237
Office Hours: Tuesdays 4:30 pm

Term: 2019 Fall
Class Meeting Days: MWF
Class Meeting Time: 12:30 am - 1:20 pm
Class Location CROL A214
Website:

Additional Notes: I will be in my office at office hours, and I am happy to discuss the material with you anytime. Make sure you send an e-mail to schedule in advance.

Course Catalog Description:
Mathematical and physical models of two- and three-dimensional imaging systems including gazing, scanning, interferometric, tomographic, and hyperspectral systems. Applications to remote sensing, biology, and medicine.

Prerequisites: EEL 3123C Networks & Systems, OSE 3101 Introduction to photonics

Detailed Course Description and Learning Outcomes:

Detailed Description:

This course introduces the basic principles of two- and three-dimensional imaging systems. It begins with the mathematical description of image formation as a linear system and draws on the student's knowledge of signals and systems to introduce the concepts of point spread function, transfer function (OTF and MTF), resolution, and restoration, for both coherent and incoherent illumination. Actual physical imaging systems (such as cameras, microscopes, telescopes, and copiers) operating in the gazing and scanning configurations are subsequently modeled and their resolution assessed. Interferometric imaging systems and their applications in metrology are described. Techniques for depth profiling are then introduced including point-by-point scanning (as in laser scanning fluorescence microscopy), echo ranging (as in radar and lidar imaging), and interferometry (as in optical coherence tomography). This is followed by an introduction to computational imaging, including the techniques of computed tomography (CT), range tomography, and magnetic resonance imaging (MRI). Spectral imaging systems using spectrophotometers in various configurations are then described including applications in detection (of tumors, for example) and classification (of different targets). Performance measures such as sensitivity and specificity are introduced. Applications for remote sensing, nondestructive testing, and biology and medicine are highlighted. The course ends with an introduction to lithography and display devices.

Learning Outcomes:

Upon completing this course, the students will be able to:

- Recognize the various configurations of imaging instruments, including gazing, scanning, interferometric, and tomographic systems.
- Select appropriate imaging modalities for various imaging applications.
- Model and simulate imaging system using linear systems principles.
- Write simple codes for tomographic and computational imaging
- Distinguish between structural and functional imaging.
- Recognize the fundamental analogies between electrical and optical systems (by virtue of the analogy between one-dimensional and two-dimensional concepts).
- Solve an unmixing problem and estimate concentrations or two materials using data produced by a spectrophotometer.

Topics: (A detailed schedule with dates follows at the end of this document.)

Introduction and overview

- Part A. Image Representation & Processing
  1. An image as: a distribution of a physical quantity, a mathematical function, an array, a matrix
  2. Introduction to Matlab Image Processing Toolbox
  3. Image processing operations: geometric transformations, contrast manipulation
  4. Linear blur. Point spread function. Resolution criteria. Matlab implementation
  5. Image processing in Adobe Photoshop
  6. Concept of spatial frequency. 1D and 2D Fourier transform. Matlab implementation
  7. Transfer function, MTF, and spatial bandwidth
- Part B. Image Acquisition
  1. Physical models of optical imaging systems. PSF, OTF, MTF, resolution
  2. Imaging instruments: microscope, camera, and telescope
  3. Image scanners, copiers, laser scanning fluorescence microscopy
  4. Axial imaging. Echo-based ranging (radar, sonar, and laser metrology)
  5. Interferometric axial imaging. Optical metrology. Optical coherence tomography (OCT)
  6. Computational imaging: X-ray computed tomography (CT)
- Part C. Color Imaging
  1. Basic theory of color. The color cube
  2. Matlab manipulation of color images

3. Multispectral imaging

- Part D. Display
  1. Printing, lithography and display. Contrast and resolution.
  2. LCD and LED flat panel display. System characteristics and specifications
  3. Color LCD and LED displays. Color rendition

Relationship of Course to ABET Criteria

ABET Criteria	Level of Emphasis During Course (Low, Medium, High)
(a) An ability to apply knowledge of mathematics, science, and engineering.	High
(b) An ability to design and conduct experiments, as well as to analyze and interpret data.	Low
(c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	Medium
(d) An ability to function on multidisciplinary teams.	Low
(e) An ability to identify, formulate, and solve engineering problems.	High
(f) An understanding of professional and ethical responsibility.	Low
(g) An ability to communicate effectively.	Low
(h) The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	Medium
(i) A recognition of the need for, and an ability to engage in life-long learning.	Medium
(j) A knowledge of contemporary issues.	Medium
(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.	High

Textbook:
Course Notes
Recommended Reference:
Introduction to Subsurface Imaging, B. Saleh, Cambridge University Press, 2011.
Other Reference Books:
Flat Panel displays, ST Wu

Course Grading and Requirements for Success:

Final Exam:

Make up Exam Policy: If an emergency arises and a student cannot submit assigned work on or before the scheduled due date or cannot take an exam on the scheduled date, the student **must** give notification to the instructor **no less than 24 hours before** the scheduled date and **no more than 48 hours after the** scheduled

Attendance:

Criteria	Grade Weighting
Homework & Quiz	20%
Term Paper	10%
Midterm Exam	30%
Final Exam	40%
Total	100%

Final Exam: Dec. 2018

Financial Aid and Attendance: As of Fall 2018, all faculty members are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete the following academic activity by the end of the first week of classes, or as soon as possible after adding the course, but no later than August 24. Failure to do so will result in a delay in the disbursement of your financial aid.

Grading Scale (%)	Rubric Description
100 ≥ A > 85	Excellent, has a strong understanding of all concepts and is able to apply the concepts in all and novel situations. Has full mastery of the content of the course.
85 > B ≥ 75	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
75 > C ≥ 65	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
65 > D ≥ 60	Below average, has a basic understanding of only the simple concepts and is able to apply to only a limited number of the most basic situations.
60 > F ≥ 0	Demonstrates no understanding of the course content.

Grade Objections:
All objections to grades should be made **in writing within one week** of the work in question. Objections made after this period has elapsed will **not** be considered – NO EXCEPTIONS.

Class Website:
Materials used for classes will be available on UCF Webcourses for download before each class.

Professionalism and Ethics:
Per university policy and plain classroom etiquette, mobile phones, etc. must be silenced during all classroom lectures, unless you are specifically asked to make use of such devices for certain activities. Academic dishonesty in any form will not be tolerated! If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule in the UCF Student Handbook (www.goldenrule.sdes.ucf.edu) for further details. As in all University courses, The Golden Rule Rules of Conduct will be applied. Violations of these rules will result in a record of the infraction being placed in your file and the student receiving a zero on the work in question AT A MINIMUM. At the instructor's discretion, you may also receive a failing grade for the course. Confirmation of such incidents can also result in expulsion from the University.

Students with Special Testing/Learning Needs:
Students with special needs and require special accommodations must be registered with UCF Student Disability Services prior to receiving those accommodations. Students must have documented disabilities requiring the special accommodations and must meet with the instructor to discuss the special needs as early as possible in the first week of classes. UCF Student Disability Services can be contacted at www.sds.sdes.ucf.edu or at (407)823-2371.

Dates:

First Day of Class	Aug. 26, 2019
Last Day to Drop Classes:	Aug. 29, 2019
Last Day to Add Classes:	Aug. 30, 2019
Final Exam:	Dec. 5-11, 2019

Week	Concepts Presented:	Notes:
1	Introduction and overview	
	Part A. Image Representation A1	
	Image Transform A2	
2	A3 Linear System	
	A3 Linear System	
	A4 Frequency analysis	
3	Off (Labor Day)	
	A4 Frequency analysis	
	A5 Fourier Transform	
4	A5 High/Low Pass Filter	
	A6 Color Imaging	
	A6 Color Imaging	
5	Part B. Image Acquisition B1 (+25 minutes)	
	Midterm Review1 (+25 minutes)	
	Off (Travel)	
6	Off (Travel)	
	Midterm Exam1	
	B1 Imaging system and physics behind lens imaging	
7	B1 Imaging system and physics behind lens imaging	
	B2 Lens physical model 1-2	
	B2 Lens physical model 3-4	
8	B3 Optical Instruments	
	B4 Axial Imaging	
	B5 Interferometry	
9	B5 Interferometry	
	B5 OCT	
	B6 Computational Imaging	
10	B6 Computed Tomography	
	Part C. Color Imaging C1/ Term Paper Topics	
	C1 Color Data Cube	
11	C2 Spectral Imaging	
	C2 Spectral Imaging	
	Midterm Review 2	
12	Midterm Exam 2	
	Off (Travel)	
	Part D. Display D1	
13	D1	
	D2 LCD	
	D3 LED	
14	D3	

	Thanksgiving	
	D4	
15	D4/ Term Paper Due	
	Presentation of Term Paper	
	Presentation of Term Paper	
16	Presentation of Term Paper	