UCF CREOL, THE COLLEGE OF OPTICS AND PHOTONICS

Course Syllabus

OSE4720 VISUAL OPTICS, 3 Cr

Instructor:	Bahaa Saleh	**Term:**	Fall 2015
Email:	besaleh@creol.ucf.edu	**Class Meeting Days:**	Monday, Wednesday
Phone:	407 882-3326	**Class Meeting Time:**	4:45 pm
Office:	CREOL Rm 207	**Class Location**	CREOL 266
Office Hours:	M,W 3:00-4:30 pm[+]	**Website:**	Webcourse

[+] I will be in my office at these times, but of course I will be happy to discuss the material with you anytime. I often get questions via e-mail that can be quickly answered.

Course Catalog Description:
Optics of the human eye and color vision. Optical and neural processing of spatial, temporal, and color information. Detection, discrimination, and recognition. Color science.

Prerequisites: OSE 3052 Introduction to Photonics

What majors require or recommend this course for graduation?
This course is one of several technical electives offered by the College of Optics and Photonics for the BS degree in Photonic Science and Engineering. The course may be taken by science and engineering and biomedical sciences students as a technical elective.

Detailed Course Description and Learning Outcomes:
Detailed Description:
This course is an introduction to optics of the human eye and physiology of the visual system. It covers optical and neural processing of temporal, spatial, and color information from an engineering viewpoint. The performance of the visual system in carrying out tasks such as change detection, brightness and texture discrimination, and recognition, will be introduced using measures such as detectability, receiver operating characteristic (ROC), modulation transfer function (MTF), contrast sensitivity function, and acuity. Various theories of depth perception will be introduced along with cues for 3D display. Mechanisms for human color perception will be reviewed and the relation between the perceived color (hue, saturation, and brightness) and the physical stimulus will be highlighted. Spectral colors and color reproduction in the printing and display industry (TV and Web), colorimetry and color image processing using MatLab tools will be included.

List of Topics: (A detailed schedule with dates follows at the end of this document.)
- Introduction & overview
- Optics of the human eye
- Imaging in the human eye using optometric measures.
- MTF and effect of aberrations, imaging quality
- Ophthalmic instruments
- Retina-brain system
- Visual sensitivity. Detectability and ROC characteristics. Role of photon noise and neural noise

- Spatial vision. Brightness vs intensity. Contrast sensitivity and modulation transfer function.
- Image quality. Acuity and hyperacuity, discrimination, and masking.
- Temporal vision. Role of eye movement. Detection of moving objects
- Depth perception. Applications to 3D display.
- Color vision.
- Color science and technology. Colorimetry and the CIE system. Color reproduction in the printing and display industry.

Learning Outcomes:

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

- describe the optics of the human eye as an image formation system and compare its features to a camera
- explain how the ophthalmoscope functions
- use a linear system model of the eye and the retina to explain the contrast sensitivity function and its measurement using psychophysical experiments
- use a photon model of light to explain the results of psychophysical experiments regarding the detectability of weak flashes of light
- describe the physical and physiological factors that limit visual acuity.
- use the principal theories of depth perception to design 3D display systems using visual cues
- describe the various representations of color (RGB, CMYK, YIQ) and convert one to another
- explain the significance of the color gamut of a display device

Relationship of Course to ABET Criteria

ABET Criteria	Level of Emphasis (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.	Low
(d) An ability to function on multidisciplinary teams.	Low
(e) An ability to identify, formulate, and solve engineering problems.	Medium
(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:

None (Class notes will be provided)

Recommended Reference:

Visual Perception, T. Cornsweet, Academic, 1970 (recommended)

Color Science, G. Wyszecki, W. Stiles, Wiley, 2005 (recommended)

Other required course material

None

Course Grading:

Homework (20%), term paper (10%), midterm exam (30%), final exam (40%)

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

Financial Aid and Attendance: As of Fall 2014, 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 27. Failure to do so will result in a delay in the disbursement of your financial aid.

Grade	Rubric Description
A	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.
B	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
C	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
D	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 situtations.
F	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	January 11, 2016
Last Day to Drop Classes	January 14, 2016
Last Day to Add Classes	January 15, 2016
Spring Break	March 7–12, 2016
Withdrawal Deadline	March 23, 2016
Final Exam:	May 02, 2016, 4:00-6:50 pm

Daily Schedule (subject to change):

Week	Date	Course material:
1	M 1/11	Introduction & overview
	W 1/13	Optics of the human eye
2	M 1/18	Imaging in the human eye using optometric measures
	W 1/20	Zmax ray tracing in the human eye
3	M 1/25	MTF and effect of aberrations,
	W 1/27	Imaging quality
4	M 2/1	Ophthalmic instruments
	W 2/3	Retina-brain system
5	M 2/8	Retina-brain system
	W 2/10	Visual sensitivity
6	M 2/15	Detectability and ROC characteristics
	W 2/17	Role of photon noise and neural noise
7	M 2/22	Spatial vision
	W 2/24	Brightness vs intensity
8	M 2/29	Contrast sensitivity. Psychophysical measurement
	W 3/2	Acuity and hyperacuity
9	M 3/7	Spring Break
	W 3/9	Spring Break
10	M 3/14	Discrimination, and masking
	W 3/16	Temporal vision. Role of eye movement.
11	M 3/21	Detection of moving objects
	W 3/23	Depth perception
12	M 3/28	Applications to 3D display
	W 3/30	Color vision
13	M 4/4	Color vision
	W 4/6	Color vision
14	M 4/11	Colorimetry and the CIE system
	W 4/13	Colorimetry and the CIE system
15	M 4/18	Color reproduction in the printing and display industry
	W 4/20	PRESENTATIONS OF TERM PAPERS
16	M 4/25	PRESENTATIONS OF TERM PAPERS
	M 5/2	FINAL EXAM