CREOL
The College of Optics and Photonics
University of Central Florida

OSE 3052: Introduction to Photonics and EEL 4440: Optical Engineering

COURSE SYLLABUS

Instructor: Dr. Patrick LiKamWa
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Recitation Instructor: Dr. Patrick LiKamWa

Term: Fall 2018
Class Meeting Days: Tuesdays and Thursdays
Class Meeting Time: 3:00 - 4:15 PM
Class Location: CREOL 102
Fridays: 12:00 – 1:00 PM in CREOL A214

Office Hours: Tuesdays: 4:30 PM – 5:30 PM
CREOL A211 Thursdays: 4:30 PM – 5:30 PM
and by appointment

I. University Course Catalog Description

Introduction to wave and photon models of light. Interference and diffraction of light. Polarization. LEDs and Lasers as generators of photons. Detectors of photons.

II. Course Overview

Introduction:

Some of the main growth areas in the "high-tech" sectors are centered on the branch of optics known as "Photonics", examples are; displays, data storage, telecommunication systems. This is not a temporary phenomenon. Continued growth of optics and photonics based industries means that there will be a growing and permanent need for engineers and scientists with some training in optics. Other areas of optics, such as bio-photonics, laser machining, laser marking, infrared imaging, etc. are growing strongly also. These topics are covered in the other courses in the Photonic Science and Engineering degree program. This course provides students with the strong foundation in optics that will be needed for the subsequent courses. We will frequently make reference to applications as we go.

Content:

This course introduces the basic descriptions of light as waves (physical optics), and photons.
Interference of optical waves is described along with interferometers and their applications to optical metrology and sensing.
Diffraction of optical waves propagating through apertures is examined and the effects on the resolution of imaging systems and the spreading and focusing of optical beams are covered.
Diffraction gratings and grating spectrometers will be studied.
The polarization of light and polarization devices used to control light will be examined.
Regarding light as photons, a brief introduction to absorption, emission, and luminescence phenomena is followed by a brief description of photonic devices such as light emitting diodes, lasers and optical detectors.
The more advanced electromagnetic properties of light are mostly postponed to the next course in the sequence: OSE 3053 Electromagnetic Waves for Photonics.

III. Course Learning Objectives

Upon completion of this course, students should understand the basic principles of modern physical optics and photonics. They should be able to read the specifications of commercial optical instruments such as a scanner for a laser printer, or a spectrometer, and determine how these specifications impact the intended application. They should also be able to solve analysis and design problems for basic optical systems such as the following examples:

- Determine the changes in the Young's double-slit interference pattern that result from bringing the slits closer by some factor.
- Determine the changes in the Michelson interferogram that result from moving one of the mirrors or inserting a thin glass slab in one of the arms.

IV. Course Prerequisites

MAP 2302 Differential Equations or EEL 3470 Electromagnetic Fields.

V. Credits

3

VI. Course Textbook

Optics, 5th ed., Eugene Hecht, Pearson, 2016.

Reference (Optional) Books

Introduction to Optics, 3rd ed., F. L. Pedrotti, L.S. Pedrotti and L. M. Pedrotti, Prentice-Hall, 2009

Schaum's Outline of Theory and Problems of Optics, Eugene Hecht, McGraw Hill, 1975.

Fundamentals of Photonics, 2nd edition B. Saleh and M. Teich, Wiley, 2007

VII. Course Requirements

- The student is expected to review the textbook, notes, and other materials before class. Occasionally you may be required to a take short quiz at the beginning of class.
- You are required to attend class as well as the mandatory discussion sessions

VIII. Course Grading

Grading Scale (%)	Rubric Description
$100 \geq A > 93 \geq A^- > 90$	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.
$90 \geq B^+ > 87 \geq B > 83 \geq B^-$	Good, has a strong understanding of most or all of the concepts and is able to apply them to stated and defined situations.
$80 \geq C^+ > 77 \geq C > 73 \geq C^-$	Average, has a basic understanding of the major concepts of the course and is able to apply to basic situations.
$70 \geq D^+ > 67 \geq D > 63 \geq D^-$	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 situations.
$60 \geq F$	Demonstrates little to no understanding of the course content.

Course Item	Percent of Final Grade
Homework	25%
Quizzes	5%
Two mid-term tests (20% each)	40%
Final Exam	35%
	105%

IX. Grading 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.

X. Professionalism and Ethics

Academic dishonesty in any form will not be tolerated. If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule, the University of Central Florida's Student Handbook (http://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.

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XI. 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 http://www.sds.sdes.ucf.edu/, or at (407) 823-2371.

XII. Excusal from Course Assignments and Course Examinations

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 date.

XIII. Class Attendance and Participation

- Regular class attendance is mandatory.
- Please be on time to class.
- Come to class prepared.

Note: The instructor reserves the right to modify the information contained in this document at his discretion.

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COURSE SCHEDULE

1	Introduction and Course Overview		General Memo - High level talk about how Photonics is everywhere around us
2	Wave Motion	Ch-2	Basic harmonic waves - The differential wave equation - Simple Harmonic Waves - Phase and Phase Velocity - Superposition Principle - The Complex Representation - Phasors and the Addition of Waves - Plane waves -The 3-D Differential Wave Equation - Spherical Waves
3	Photons and Light	Ch-3	Photons as a wave packet - The Wave-Particle Duality - DeBroglie's Principle - The energy of the photon through Einstein relation E = hf - Concept of photon flux and optical power - How for small optical powers the large number of photon/s leads to continuous waves - Single and few photons concepts in imaging - Initial concepts of discrete atomic energy for photon emission.
4	The Superposition of Waves	Ch-7	Addition of coherent waves - Algebraic, Complex and Phasor Additions - Superposition of Waves with different frequencies - Group Velocity and Dispersion - Fourier Series
5	Polarization	Ch-8	Linear Polarization - Malus Law - Polarization by Reflection (Brewster Law)
6	Interference	Ch-9	Temporal and Spatial Coherence - Fresnel-Arago Laws - Young's Experiment - Fresnel's Double Mirror and Lloyd's Mirror - Thin Film Interference - Fizeau Interferometer - Michelson Interferometer - Mach-Zehnder Interferometer - Sagnac Interferometer - Fabry-Perot Interferometer - Single Layer Anti-reflection Coating
7	Diffraction	Ch-10	Fraunhofer vs Fresnel Diffraction - The Single Slit - The Double Slit - Diffraction by Many Slits - Rectangular Aperture - Circular Aperture - Airy Disk - Diffraction Grating - Spectral Resolving Power
8	Fourier Analysis	Ch-11	Fourier Transforms - The Lens as a Fourier Transformer
9	Lasers and LEDs	Ch-13	Blackbody radiation - Planck's radiation law - Gas Discharge Lamps - Fluorescent Lamps - Spontaneous Emission, Stimulated Emission and Absorption - Einstein A, B coefficients - The LASER Principle - egs Ruby, HeNe - Threshold Condition - Longitudinal Modes - Semiconductor Energy Bands - Fermi levels and p-n junctions - Hetero-junctions - The Laser Diode - The LED - Extraction Efficiency - The White LED -
10	Photodetectors	Notes	The Photoconductor - The Junction Photodiode as a Photodetector and Solar Cell.

Note: The dates of the topics will be posted on Webcourses and are subject to change depending upon how things progress during the course of the semester