ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING DEPARTMENT

ABET COURSE SYLLABUS

ECSE-4630 Lasers and Optical Systems

Course Catalog Description: Optical physics and applications of lasers. Design of optical systems. Topics include: wave optics and beam propagation, Gaussian beams, resonators, optical properties of atoms and laser gain media, laser amplifiers, pulsed laser systems, applications of lasers, nonlinear optics. Three lecture hours and three laboratory hours per week. (Cross listed as PHYS-4630. Students cannot receive credit for both this course and PHYS-4630). Prerequisite: PHYS-2620 recommended. Fall term odd-numbered years. *4 credit hours*

Pre-Requisite Courses: PHYS-2620 Fundamentals of Optics (recommended)

Co-Requisite Courses:

Prerequisites by Topic:

1. Geometric optics
2. Maxwell's equations
3. Electromagnetic wave propagation
4. Basic semiconductor theory
5. Carrier motions: drift and diffusion

Textbook: (and/or other required material) *Optics*, Miles Klein, Thomas E. Furtak, Wiley & Sons, Inc., 2nd ed. 1985
Optoelectronics and Principles and Practices, S.O. Kasap, Prentice Hall 2001

References:

Course Coordinator: Zhaoran Rena Huang, Assistant Professor, Electrical, Computer and Systems Engineering

Overall Educational Objective: An introductory survey of optics and optoelectronics technology emphasizing fundamentals in basic optical phenomena (reflection, transmission, wave guiding in waveguide and fiber, interference, diffraction polarization), physical principles of optical modulators (birefringence, retarding plates, phase compensator, Mach-Zehnder modulator), operation of optoelectronic devices (photodetectors, light emitting diodes, laser diodes, solar cells). This course prepares the students for a more in-depth study of selected topics when they attend graduate school.

Course Learning Outcomes:

1. Understanding basic optics phenomena
2. Quantitatively analyze basic optical problems.
3. Understand the working principles of optoelectronics devices
4. Understand the physics of optical modulation
5. Use optoelectronic devices and modulators in different application areas
6. Obtain experience in the laboratory

How Course Outcomes are Assessed:
Quiz 1: Fundamental Optics 35%
Quiz 2: Optoelectronic devices 35%
Laboratory: 20%
Homework: 10%

Relation to EE/CSE/EPE Outcomes

N = none
M = moderate
H = high

Outcome	Level	Demonstrate Proficiency
	N, M, H	e.g. Exams, projects, HW
Mathematics, science and engineering	H	HW, Quizzes
Basic disciplines in Electrical Engineering	M	HW, Quizzes
Depth in Electrical Engineering	H	HW, Quizzes
Basic disciplines in Computer & Sys. Eng.	N	
Depth in Computer and Systems Eng.	N	

Electromagnetics, electromechanics, power semiconductors	N	
Power system behavior	N	
Electrical energy conversion	N	
Conduct experiments and interpret data	M	HW, Labs
Identify, formulate and solve problems	H	HW,Quizzes, Labs
Design a system, component or process	N	
Communicate in written and oral form	N	
Function as part of a multi-disciplinary team	N	
Preparation for life-long learning	N	
Ethical issues; safety, health, public welfare	N	
Humanities and social sciences	N	
Laboratory equipment and software tools	M	Labs
Variety of instruction formats	N	

Topics Covered:
(number of hours or classes for each)

1. Maxwell's equations and boundary conditions (2 hours)
2. Energy density, group velocity and group index of optic waves (2 houses)
3. Amplitude relationship of reflection and transmission at an interface (4 hours)
4. Fundamentals of waveguides and optical fibers (5 hours)
5. Interference and antireflection coating (4 hours)
6. Far-field diffraction and fundamentals of Fourier optics (5 hours)
7. Near-field diffraction (2 hours)
8. Polarization (3 hours)
9. Modulators (2 hours)
10. Photodetectors (Pin, MSM and avalanche photodiode) (4 hours)
11. Light emitting diodes (heterojunction LEDs) (4 hours)
12. Laser basics (3 hours)
13. Laser diodes (DBR, DFB, VCSEL) (2 hours)
14. Solar cell (1 hour)

Computer Usage: Student needs to use Matlab or Mathematic to generate plots for their homework

Laboratory Experiences:

1. Laboratory experiment: Optical properties of LEDs

Design Experiences:

Independent Learning Experiences:

Class/Lab Schedule: 12 to 1:50pm on Tuesday and Friday

Contribution to the Professional Component:

(a) College-level mathematics and basic sciences:	1 credit hours
(b) Engineering Topics (Science and/or Design):	3 credit hours
(c) General Education:	0 credit hours

Prepared by:	Z. Rena Huang
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