ELECTRICAL, COMPUTER, AND SYSTEMS ENGINEERING DEPARTMENT

ABET COURSE SYLLABUS

ECSE/PHYS 4640: Optical Communications and Integrated Optics

Course Catalog Description: Phenomena, materials, and devices for optical communications and selected topics in integrated and nonlinear optics. Topics include: guided wave and fiber optics, integrated optics, optical interactions in semiconductors, semiconductor lasers, detectors, and light emitting diodes, electro-optics, acousto-optics, and other selected topics. Three lecture hours and three laboratory hours per week.

Pre-Requisite Courses: PHYS-2620 Fundamentals of Optics

Prerequisites by Topic:

1. Electromagnetism
    a. Maxwell's Equations
    b. Wave Mechanics
    c. Gaussian Beams and Beam Optics
    d. Normal Modes and Boundary Value Problems
2. Optical Properties of Dispersive Media
    a. Refractive index = n (ν)
    b. Reflection and refraction.
3. Basic properties of semiconductor materials
    a. Unit cell
    b. Band structure
    c. Wave propagation
4. Absorption and emission of photons in semiconductors
5. Material science (growth of semiconductor epi layers)
6. Some use of quantum mechanics (not detailed, but knowledge is helpful)
7. Mathematics
    a. MatLab, MAPLE or other tool
    b. Functions (Gaussian, Bessel, etc.)
    c. Differential equations (separation of variables, boundary conditions)
    d. Plane and solid geometry, trigonometry, Fourier transforms, advanced calculus, matrix math, and complex representation of physical quantities.

Textbook: Photonics by B.E.A.Saleh & M.C.Teich

Course Coordinator: Morris Washington

Overall Educational Objective: Survey the physics and devices of optical communications, and integrated optics for upper level undergraduate and graduate physicists and engineers.

Course Learning Outcomes:

1. Develop an understanding and appreciation of the enormous information bandwidth of optical communication.
2. Learn the function and required characteristics of each component of an optical communication system.
3. Explain the principles of, compare and contrast single- and multi-mode optical fiber characteristics.
4. Analyze and design optical communication and fiber optic sensor systems.
5. Design, build, and demonstrate optical fiber experiments in the laboratory.
6. Locate, read, and discuss current technical literature dealing with optical fiber systems

How Course Outcomes are Assessed:

50% one-hour exams
40% homework
10% final paper

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	Exams, HW, Paper
Basic disciplines in Electrical Engineering	N	
Depth in Electrical Engineering	H	Exams, HW, Paper
Basic disciplines in Computer & Sys. Eng.	N	
Depth in Computer and Systems Eng.	N	
Basic disciplines in Electric Power Eng.	N	
Conduct experiments and interpret data	N	
Identify, formulate and solve problems	M	Exams, HW, Paper
Design a system, component or process	N	
Communicate in written and oral form	M	Exams, HW, Paper
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	Exams, HW, Paper
Variety of instruction formats	N	

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

1. Introductory/Review material (4 hours)
2. Beam Optics (4 hours)
3. Electromagnetic Optics (4 hours)
4. Fiber Optics (4 hours)
5. Resonator Optics (4 hours)
6. Photons in Semiconductors (4 hours)
7. Semiconductor Lasers & Light Sources (4 hours)s
8. Semiconductor Photon Detectors (4 hours)
9. Electro-Optics (4 hours)
10. Fiber-Optic Communication (4 hours)
11. Optical Amplifiers (4 hours)
12. Nonlinear Optics (4 hours)
13. Acousto-Optics (4 hours)

Computer Usage: Write simple programs and plot in some computer environment (i.e. – MATLAB, MAPLE, C, BASIC, EXCEL)

Laboratory Experiences: None

Design Experiences: None

Independent Learning Experiences: Final Paper: Students choose a relevant topic and discuss it at the level of this course in a short (~ 5 page) paper.

Class/Lab Schedule: Tuesday and Friday, 2-3:50 pm

Contribution to the Professional Component:

(a) College-level mathematics and basic sciences:	2 credit hours
(b) Engineering Topics (Science and/or Design):	2 credit hours
(c) General Education:	0 credit hours

Prepared by:	Morris Washington
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