Rutgers University, Department of Electrical and Computer Engineering
ABET COURSE SYLLABUS
COURSE: 14:332:466

Course Catalog Description: 14:332:466 Optoelectronic Devices (3)

Pre-Requisite Courses: 14:332:361, 382, 481

Co-Requisite Courses: None

Pre-Requisite by Topic:

1. Electromagnetic Fields and Waves
2. Ordinary Differential Equations
3. Integral Calculus
4. Vector Analysis

Textbook & Materials: J.Wilson and J.F.B. Hawkes, *Optoelectronic: An Introduction*, Prentice-Hall, 1993

References: None

Overall Educational Objective: 1. To introduce the student to the concepts, physical operations, and design criteria of state-of-the art optoelectronic devices and systems used in research, technology, medicine communication, etc.

Course Learning Outcomes: A student who successfully fulfills the course requirements will have demonstrated:

1. An understanding of the relationship between vision and state-of-the art optoelectronic technology.
2. An introduction to quantum mechanics and its role in the design and operation of optoelectronic devices.
3. An overview of the current state and design of cathode ray tubes, light emitting diodes, liquid crystal displays and plasma displays.
4. An in depth analysis of laser theory and rate equations in the design of lasers; and an overview of laser resonators and laser types.
5. An in depth analysis of optical fibers and the design of fiber optic systems for communications, including detectors and couplers.

How Course Outcomes are Assessed:
HW Problems (15%)
Laboratory and Design Projects (25 %)
One Mid-Term Exam (30 %)
Final Exam (30 %)

N = none S = Supportive H = highly related

Outcome	**Level**	**Proficiency assessed by**
(a) an ability to apply knowledge of Mathematics, science, and engineering	H	HW Problems, Projects, Exams
(b) an ability to design and conduct experiments and interpret data	S	Design problems in HW, Projects and Exams
(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	H	Design Projects
(d) an ability to function as part of a multi-disciplinary team	N	
(e) an ability to identify, formulate, and solve ECE problems	H	HW Problems, Projects, Exams
(f) an understanding of professional and ethical responsibility	S	Lectures, Projects
(g) an ability to communicate in written and oral form	S	HW Problems, Project Presentation
(h) the broad education necessary to understand the impact of electrical and computer engineering solutions in a global, economic, environmental, and societal context	S	Lectures, Projects
(i) a recognition of the need for, and an ability to engage in life-long learning	S	Lectures, subsequent courses
(j) a knowledge of contemporary issues	S	Lectures
(k) an ability to use the techniques, skills, and modern engineering tools necessary for electrical and computer engineering practice	H	HW and Design Projects
Basic disciplines in Electrical Engineering	H	HW, Projects, Exams
Depth in Electrical Engineering	S	HW, Projects, Exams
Basic disciplines in Computer Engineering	N	
Depth in Computer Engineering	N	
Laboratory equipment and software tools	S	Lab Projects, MATLAB
Variety of instruction formats	S	Lectures, Problem sessions, Office hour discussions, Project Presentations

Topics Covered week by week:

Week 1: Human Vision; Functions of the Eye; Spectral response of the eye; Errors of Refraction and their correction; The Eye Chart; Color vision, color blindness; Critical fusion frequency

Week 2: Review of Electromagnetic Theory; Derivation of Snell's Laws and Fresnel's equations; critical angle and Brewster's angles.

Week 3: Introduction to Quantum Mechanics: deBroglie wavelength; uncertainty principle; Schrodinger's equation; Free Particle; Infinite Well

Week 4: Introduction to solid state physics: dielectrics, conductors and semiconductors; carrier concentration; pn junction

Week 5: Cathode Ray Tubes: TVs, monitors and oscilloscopes; Light emitting diodes (LEDs), including spec sheet evaluation

Week 6: Liquid crystal displays (LCDs); Plasma Displays

Week 7: MINI-LAB 1: Characteristics of LED
MINI-LAB 2: Construction and Analysis of 2-LED Multiplexing Circuit

Week 8: Absorption, spontaneous emission, stimulated emission; Einstein's relations; population inversion, gain, laser threshold

Week 9: Laser rate equations; Laser modes: axial and transverse; Laser resonantors; Laser types

Week 10: Optical fibers: step, graded; multimode and single mode

Week 11: Transmitters: Semiconductor lasers (ILDs) and Light emitting diodes (LEDs)

Week 12: PIN and ADP photodiodes; detector performance parameters

Week 13: Coupling to transmitters and detectors

Week 14: Fiber optic system design considerations

Week 15: Overview of photodetectors: thermal (thermoelectric, bolmeter, pneumatic and pyroelectric), and photonic (photoemissive, vacuum, photomultipler, photoconductors)

Week 16: Final Examination

Computer Usage: Simulations using MATLAB.

Laboratory Experiences: There are two LED laboratories.

Design Experiences: ~50% Homework problems are design-oriented problems.

Independent Learning Experiences: 1. Home-Work, 2. LED Laboratories, 3.Testing (Projects, Exams)

Contribution to the Professional Component:
(a) College-level mathematics and basic sciences: 0.25 credit hours
(b) Engineering Topics (Science and/or Design): 2.75 credit hours
(c) General Education: 0 credit hours
Total credits: 3
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