PURDUE
UNIVERSITY

SCHOOL OF ELECTRICAL
AND COMPUTER ENGINEERING
UNDERGRADUATE ADVISING OFFICE

To: The Engineering Faculty
From: School of Electrical and Computer Engineering
Re: ECE 30414

The School of Electrical and Computer Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ECE 30414 Elements of Fiber Optics, Lasers and Optoelectronics
Semesters offered: Fall
Non-repeatable
Credit 3

Pre/Co-requisites:
ECE 30100
ECE 30411 or 31100
MA 26200 or (MA 26500 and (MA 26600 or MA 36600))

Course Description
Fundamental of photonics, guided-wave optics, optical fibers, lasers, photon detectors, integrated optical components, optical information processing, devices in communication and sensor applications. Topics include generation, transformation, modulation and detection of laser beams and their applications.

Reason
This is a new courses in the ECE Optics path that introduces students to ray and wave optics and focuses on guided-wave and fiber optics, lasers and detectors.

History of Previous Offering
This is a new course.

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ECE 30414 - Elements of Fiber Optics, Lasers and Optoelectronics

Lecture Hours: 3 Credits: 3
Professional Attributes
EE Elective

Normally Offered: Each Fall

Course Prerequisites and Co-requisites:

This class is designed for advanced undergraduate students. Official co-requisites are ECE 301 (Signals & Systems) and ECE 311 (Electromagnetism). Ideally, you should be comfortable with these topics: differential equations, matrix algebra, electric circuits, semiconductor devices, electromagnetism (Maxwell's equations), and the propagation, reflection, and refraction of plane waves.

Prerequisites by topics: Uniform plane waves, reflection and refraction of plane waves, rudimentary differential equations and matrix algebra, basic concepts in electric circuits and in semiconductor devices, basic concepts of electromagnetism, Maxwell's equations

Catalog Description:
Fundamental of photonics, guided-wave optics, optical fibers, lasers, photon detectors, integrated optical components, optical information processing, devices in communication and sensor applications. Topics include generation, transformation, modulation and detection of laser beams and their applications.

Course Objectives:
The course begins with a brief introduction to ray and wave optics and focuses on guided-wave and fiber optics, lasers and detectors as well as their use in communication and other electrical engineering applications. Topics are selected to emphasize the application of prerequisite material in electrophysics and systems areas of modern devices and systems.

Supplementary Information:
Will be offered fall only semesters effective fall 2016.

Required Text(s):
Fundamentals of Photonics (Wiley Series in Pure and Applied Optics); Bahaa E. A. Saleh (Author), Malvin Carl Teich (Author); Publisher: Wiley-Interscience; 2 edition (March 9, 2007); Language: English; ISBN-10: 0471358320; ISBN-13: 978-0471358329
It is available as a hard copy through commercial booksellers, and through the Purdue Engineering library reserve desk, Dewey Decimal classification number 621.36 Sa32f 2007.

*The **supplementary textbooks** for those interested in the topics are "Fiber-Optic Communication Systems," by Govind P. Agarwal, John Wiley & Sons, ISBN 0-471-21571-6, and "Photonic Crystals," by John D. Joannopoulos et alia, Princeton University Press, ISBN 978-0-691-12456-8. Both are available in hard copy through commercial booksellers/Purdue libraries. The latter is also available as a soft copy through the author's website, via the following link: http://jdj.mit.edu/book*

Learning Outcomes:

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

i. to analyze simple optical systems including dielectric slabs, thin lenses, reflectors, and optical resonators. [1]

ii. to analyze optical waveguides, examine fiber modes and waveguide properties [1]

iii. a knowledge of the operations of gas lasers, semiconductor lasers and light emitting diodes. [1]

iv. a knowledge of operational principles of optical detectors, including various optical detection schemes. [1]

v. an understanding of the key components of optical fiber communication systems. [1]

vi. a basic understanding of novel concepts in photonics, including ultrafast optics, photonic crystals, optical interconnects, metal optics, and metamaterials. [1]

Lecture Outline:

Lecture #	Topic
1	Overview of the course, introduction
2	Fundamentals of Ray optics and resonator optics
3-4	Simple optical components
5-6	Ray matrices, resonators
7	Fundamentals of wave optics
8	Fundamentals of electromagnetic optics
9	Guided-wave optics: planar waveguides
10	Dielectric waveguides
11	Photonic crystal optics
12-13	Fiber optics
14	Photonic Crystal (Holey) Fibers
15	Lasers: Review of energy levels
16	Transition between energy levels and population inversion
17	Rate equations
18-20	Survey of laser systems: common laser amplifiers, common CW and pulsed lasers
21	Semiconductor optical sources: Basic parameters of semiconductor light sources; Light emitting diodes
22-23	Semiconductor injection lasers
24	Semiconductor optical sources: Material and fabrication
25	Semiconductor photon detectors: Types and characterization
26	Coherent and incoherent detection, Noise
27	Fiber communication systems
28	Modulations and deflection of beams: Introduction to Electro- and acousto-optics
29-30	Current research in photonics
2 tests, and final	