PURDUE
UNIVERSITY

SCHOOL OF ELECTRICAL
AND COMPUTER ENGINEERING
UNDERGRADUATE ADVISING OFFICE

To: The Engineering Faculty
From: School of Electrical and Computer Engineering
Re: ECE 30416

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 30416 Basics of Engineering Optics
Semesters offered: Spring
Non-repeatable
Credit 3

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

Course Description
Basic control over propagation, reflection, refraction of optical radiation are covered. Applications to optical instrumentation such as microscopy, polarization optics such as wave plates, thin films, and holography are discussed. Geometrical optics including lenses, mirrors, prisms; Huygens' principle, Fermat principle; rays; incoherent light. Physical Optics including gratings, interferometers, diffraction elements, polarizers; Huygens-Fresnel principle. Waves, amplitude and phase, coherent light. Law of reflection and refraction, interference, diffraction, polarization.

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 30416 – Basics of Engineering Optics

Lecture Hours: 3 Credits: 3
Professional Attributes
EE Elective

Normally Offered: Each Spring

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, electromagnetism (Maxwell's equations), uniform plane waves, reflection and refraction of plane waves, basics of Fourier series and Fourier transforms.

Requisites by Topic:
Basic concepts of optics such as refractive index, wave propagation, uniform plane waves, reflection and refraction of plane waves, Maxwell's equations, beams, Gaussian beams

Catalog Description and Major Topics:
Basic control over propagation, reflection, refraction of optical radiation are covered. Applications to optical instrumentation such as microscopy, polarization optics such as wave plates, thin films, and holography are discussed. Geometrical optics including lenses, mirrors, prisms; Huygens' principle, Fermat principle; rays; incoherent light. Physical Optics including gratings, interferometers, diffraction elements, polarizers; Huygens-Fresnel principle. Waves, amplitude and phase, coherent light. Law of reflection and refraction, interference, diffraction, polarization.

Supplementary Information:
Will be offered spring only semesters effective fall 2016. **Students are also suggested to consider taking the lab course ECE 30417 together with this course.**

Required Text(s):

1. *Fundamentals of Photonics*, E.A. Saleh & Malvin Carl Teich, 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.

Supplementary Text(s): "Optics" by E. Hecht, 4th ed., 2002 ISBN No. 080-538-5665

Course Objectives and Learning Outcomes:

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

i. An ability to analyze simple optical systems (dielectric slabs, thin lenses, reflectors). [1]
ii. An ability to model Gaussian beams and the transformation of beams. [1]
iii. An ability to analyze and design polarization systems, including polarizers and wave plates. [1,2]
iv. A knowledge of optical interferometers and the operations of interferometers such as the Michelson, Fabry-Perot and double-slit. [1]

v. An ability to analyze diffraction patterns. [1]

Lecture Outline:

Lectures	Topic
1-11	Overview of the course (1) - Ray Optics (10): Reflection, Refraction, Snell's Law (1) Huygens principle, Fermat principle (1), Simple optical components, Reflectors, Mirrors, Prisms (2), Thin lenses (1), Thick lenses, lens systems (1), Chromatic and achromatic aberrations (2), Ray matrices (2)
12-20	Wave Optics (9): Monochromatic waves, Optical components, Reflection and refraction by EM approach (2), Diffraction gratings (1), Superposition of waves (1), Interference (2), Two-beam interferometers, Temporal coherence (2), Multiple-beam interferometers, Thin films (1), Spatial coherence (1)
21-26	Beam Optics (5): Gaussian beams (3), Transmission through optical components (2)
27-32	Polarization Optics (6): Polarization, Jones Calculus (2), polarizers Waveplates (1), Optical Activity, Liquid Crystals (2), Faraday Rotation, Optical Isolators (1)
33-40	Fourier Optics (8): Plane waves, Huygens-Fresnel principle (1), Optical Fourier transform (1), Diffraction, Fraunhofer diffraction, Fresnel diffraction (2), Image formation, Filtering, Transfer function (3), Holography (1)
4	2 Midterms and r2 eview sessions