EE 475 Optical Communications

Credits: 3

Categorization of credits: engineering topic

Instructors or course coordinator: Aaron Ohta

Textbook and Other Required Materials:

"Computer Organization and Design: The Hardware/Software Interface" by Patterson and Hennessey

Designation: Elective

Catalog Description: EE 475 Optical Communications (3) Principles and applications of optical fibers and waveguides. Fundamentals of optical communication systems (optical links, high-speed systems, wavelength-division-multiplexing networks, and network elements) and optical components (guided-wave circuits, lasers, detectors, and optical amplifiers). System and network integration issues. A-F only. Pre: 372 or consent. DP

Pre-requisites: EE 372 (Engineering Electromagnetics II) or consent.

Class/Lab Schedule: 3 lecture hours per week

Topics Covered:

- Review of Network Topologies and Review of Communication Theory (2 hours)
- Principles of Optical Propagation: Review of EM theory, Propagation in Dielectric waveguides, Optical Fibers (8 hours)
- Optical Sources: Review of Physical Electronics, LEDs, Laser diodes, and other coherent optical sources (6 hours)
- Techniques for Power launching and Coupling: Source to fiber launching and fiber to fiber launching (2 hours)
- Physics of Optical Detectors: Photoconductive materials and Photodiodes (5 hours)
- Noise in Optical Communications: Noise characterization, noise sources, and noise in optical com elements (6 hours)
- Optical Modulators: Direct modulation, Electro-optic modulation, Electro-optic phase modulation, Acousto-optic modulation (4 hours)
- WDM Concepts and Components (4 hours)
- Optical Amplifiers: Front-end amplification, EDFA, OSA, Raman Amplifiers, Noise considerations (4 hours)
- Principles of Nonlinear Optics (2 hours)

Course Objectives and Their Relationship to Program Objectives:

EE 475 addresses fundamental and contemporary issues of optical communications, communication components, and state-of-the-art applications found in current literature

publications. A student should understand (i) propagation of light in fiber, (ii) the principals of operation of active and passive optical communication components, and (iii) the principles of designing optical communication systems. A student should be able to design and technically analyze optical communication systems. In addition, students should be able to search for, reference, and critically review primary journal articles in the field of optical communications. [Program Objectives this course addresses: 1,2,3,4,5.]

Course Outcomes and Their Relationship to Program Outcomes:

The following are the course outcomes and the subset of Program Outcomes (numbered 1-7 in square braces "[ ]") they address:

- Understand the propagation of light in optical fiber. [1, 2]
- Understand the principles governing optical sources and amplifiers used in optical communications. [1, 2]
- Design optical communication systems to serve a defined purpose. [1, 2]
- Analyze optical systems for performance and utility. [1, 2, 4]
- Critically review and summarize modern topics in optical communications. [1, 3, 4, 7]

Contribution of Course to Meeting the Professional Component

Engineering Topics: 100%

Computer Usage:

The course makes use online databases and resources for references, as well as word processing programs for preparing papers. The course has a web site, which has downloadable lecture notes, homework documents, and reference links.

Design Credits and Features:

EE 475 has 1.5 design credits. About 20% of the homework assignments involve designing components of optical communication systems. One of the two mid-term exams involves design problems and the final exam is completely design oriented.

Person Preparing Syllabus and Date: A. Bullock, Mar. 16, 2003. Modified by A. Ohta, Oct. 14, 2014; A. Ohta, Jan. 20, 2021.

EE 477 Fundamentals of Radar, Sonar, and Navigation Systems

Credits: 3

Instructor(s): Zhengqing Yun.

Text Book and Other Required Materials:
Text: Fundamentals of physical acoustics, by D. T. Blackstock, Wiley-Interscience, 2000.High-Resolution Radar, second edition, by D. R. Wehner, Artech House, 1995.
Supplements: Introduction to Radar Systems, third edition, by M. I. Skolnik, McGraw-Hill, 2001.

Prerequisites: EE371 Engr Electromagnetics
Class/Lab Schedule: 3 lecture hours per week

Designation: Optional

Catalog Description:
Acoustics, sonar, ray theory, antennas for radar, radar cross section, radar systems, propagation, navigation systems, GPS

Topics Covered:

This course covers the fundamental concepts of radar, sonar, and navigation systems. The topics covered are

- Acoustics and Sonar: Basic solution of plane waves, wave equation derivations, spherical & cylindrical waves, R &T coefficients, single Z termination, lumped element approximation, wall transmission loss, vibrating string, ray theory (20 hrs)
- Radars: Radar frequencies, antennas for radars, range resolution and bandwidth, Nyquist sampling, Doppler effect and resolution, radar cross section, fundamental aspects of electromagnetics, scattering, and diffraction in radar systems. (18 hrs)
- Navigation systems : GPS, propagation. (2 hrs)

Course Objectives and Their Relationship to Program Objectives:
The student learns the fundamentals of physical acoustics and sonar, basic radar principles, and modern navigation systems and general propagation phenomena. [Program Objective this course addresses: 1,2,3,4,5]

Course Outcomes and Their Relationship to Program Outcomes:
The following are the course outcomes and the subset of Program Outcomes (numbered 1-11 in square braces "[ ]") they address:

- Use of physical acoustics, electromagnetics, wireless communications, and mathematics to understand fundamentals of radar, sonar, and navigation systems. [1,2, 3,5,9]
- Develop the ability to understand and design basic sonar, radar, and navigation systems [1,2,3,5,8,9,10,11]

Contribution of Course to Meeting the Professional Component
Mathematics: 50%, Physics: 50%

Computer Usage:
Computer usage is minor. Computer language program (Matlab, C++, Fortran, etc.) is used to verify some concepts derived in class and in homework problems.

Design Credits and Features:
EE 474 has 0 design credits.

Person(s) Preparing Syllabus and Date: Zhengqing Yun, 9/29/2014.