

EET 440
Fiber-optics & Communications
Fall 2006

Instructor:

Prof. Vigs Chandra, PhD

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Class schedule:

Section 001, CRN 11686; TR: 8:00 am – 9:50 am, in Room 407/403

Office Hours:

MWTR: 10 am – 11 am, 4.30 pm – 6 pm. If my office door is open at other times I will most likely be available for discussion. Come right in.

Credit hours:

3

Prerequisite:

EET257, MAT108

COURSE DESCRIPTION:

Principles of communication over fiber and other media. Digital and analog data transmission. Modulation and multiplexing of data. Functioning of various fiber- optic system components. Safety, testing and troubleshooting of single and multi-mode systems. Design, simulation and implementation of communication circuits in a combination of lecture, demonstration, and laboratory. The network simulation software OPNET[®] will be used for studying various networking technologies.

TEXTBOOK:

Understanding Fiber Optics, 4th or 5th edition; Jeff Hecht; Prentice Hall publishers;
ISBN: 0130278289 (4th ed.), 0131174290 (5th ed.)

COURSE OBJECTIVES:

1. Understand basic concepts of light propagation, stimulated emission, inversion and absorption.
2. Describe the safety precautions while handling and troubleshooting fiber-optic based systems.

COURSE OBJECTIVES (continued):

3. Understand the features and functionality of various fiber-optic components – cables, sources, transmitters, receivers, connectors, couplers, switches.
4. Implement electronic circuits for fiber-optic based communication.
5. Design fiber-optic systems for sustaining a given data-rate based on transmission losses and budgeting of power.
6. Analyze the operation of different network configurations, and optical networks using the simulation software OPNET[®]. Design and simulate the computer networks using OPNET[®].

COURSE OUTLINE:

1. Introduction to Fiber Optics and Components
 - i. Use of fibers in communications
 - ii. Basic fiber concepts
 - iii. Emerging optical networks
 - iv. Basics of optics, light guiding and optical components
2. Fiber-optic measurements, test equipment
 - i. Optical power, wavelength and frequency measurement
 - ii. Phase, interference and polarization measurements
 - iii. Time, bandwidth, signal quality measurements
 - iv. Instruments used in fiber-optic troubleshooting
3. Fundamentals of communications
 - i. Analog, digital, and fiber-optic communications
 - ii. Signals Formats
4. Optical fibers – types, properties, materials, manufacturing, cabling
 - i. Light guiding
 - ii. Use of different modes of fiber in communications
 - iii. Materials and processes used in making optical fibers
 - iv. Special purpose fibers
 - v. Cabling
5. Light Sources
 - i. LED and laser sources
 - ii. Types of lasers
 - iii. Safety precautions while handling lasers
 - iv. Optical amplifiers
6. Optical transmission, reception
 - i. Transmitters
 - ii. Using multiple optical sources – wave division multiplexing (WDM), optical switching networks
 - iii. Modulation principles
 - iv. Detector basics
 - v. Sample transmitter and receiver circuits
 - vi. Signal degradation, use of repeaters, regenerators and amplifiers

7. Connectors, splices and couplers
 - i. Internal reflections
 - ii. Signal attenuation
 - iii. Connectors – structures, installation, types
 - iv. Splicing
 - v. Coupler types, technologies

8. Optical networks, system standards, networking design
 - i. Evolving networks and telecommunications structure
 - ii. Transmission topologies, formats, capacities
 - iii. Fiber transmission, and optical networking standards
 - iv. Use of WDM, switching, amplification in optical network design

9. Fiber optics in global, regional and local communications
 - i. Global networks – joining networks, terrestrial and long-distance systems
 - ii. Regional networks – design of regional and metropolitan networks
 - iii. Local networks – emerging services, passive networks, Gigabit Ethernet and Internet protocols, computer and phone networks, types of communications links
 - iv. Cable television networks – digital and cable systems
 - v. Mobile fiber-optic communications – robotic vehicles, fibers in aircraft systems

COURSE REQUIREMENTS:

1. Complete all homework and reading assignments, simulation experiments and submit these on the prescribed dates.
2. Complete assigned laboratory work and project/term paper as prescribed by the instructor.
3. Complete the assessments covering material from: homework, labs, and from assigned readings in the text.
4. Maintain a 3-ring binder or folder for organizing class materials.

EVALUATION:

Each student will be evaluated as follows:

- Assessments (45%) – 3 assessments
- Lab assignments (30%) – between 10-15 lab assignments, including network simulations
- Fiber-optic technology design project/Research paper and presentation (15%)
- Homework (10%) – around 10-12 homework assignments, or 1-page papers on fiber-optics

Field-trip to Adelphia – attendance and 1-page report required. It will count as 1 lab activity.

1st assessment – (in-class, 1 page of notes permitted), covering chapters 1 – 6, parts of 17 & 18

2nd assessment – (in-class, 2 pages of notes permitted), covering chapters 7 – 14

Final Assessment – (in-class, open-book and notes), **Comprehensive**, covering chapters 1 – 24

The final assessment will be weighed more than the 1st and 2nd assessment.

You may rework and resubmit your assessments (excluding the final), assignments or labs for limited partial credit.

Design project/ Research paper and presentation: You may work in teams of 2-3 students. For your term paper, research articles of interest in the area of fiber-optic technology, networking of computer systems, especially those using fiber optic components. Other options include study of the reliability, safety, industrial applications, different protocols used in the fiber. You may alternatively choose to design and simulate optical networks using OPNET[®], run comparative studies of fiber vs. different types of media used in networks, even design and implement a small scale fiber-optic computer interfaced communication system.

A group presentation of your work is required and will be graded both by me and other students. An individually written detailed report, around 6-10 pages in length, and with appropriate bibliographical references [in American Psychological Association (APA) format <http://nutsandbolts.washcoll.edu/apa.html>], is required as well.

Attendance Policy:

After the second unexcused absence, each unexcused absence will cause one percent deduction in the overall percentage. Five (5) and seven (7) unexcused absences will result in one letter grade lower each. Your grade will be an automatic F if you have more than seven (7) unexcused absences. Makeup labs/exams will be permitted only if you had sought and received my approval prior to the absence which caused you to miss the related lab/exam.

A **Field-trip** is planned during the semester to Adelphia, located in Richmond, which extensively uses fiber-optic based communication equipment. Attendance is encouraged, and is part of the grade for the class. Other field-trips can be undertaken as time permits.

Grades:

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|---------|---|---|-----------|---|---|
| 100-90% | = | A | 69-60% | = | D |
| 89-80% | = | B | Below 60% | = | F |
| 79-70% | = | C | | | |

Mid-term grades will be made available to students before Friday, October 6, 2006.

STATEMENT OF DISABILITY:

ADA

If you are registered with the Office of Services for Individuals with Disabilities, please make an appointment with the course instructor to discuss any academic accommodations you need. If you need academic accommodations and are not registered with the Office of Services for Individuals with Disabilities, please contact the office on the third floor of the Student Services Building, by email at disabilities@eku.edu or by telephone at (859) 622-2933 V/TDD. Upon individual request, this syllabus can be made available in alternative forms.

☺ The work you do in the laboratory, and the grade you earn, should reflect your personal abilities, and accomplishments. Individual homework and lab reports are required from each student. I encourage you to discuss your assignments with other students. However any work you submit must be your own.

☺ Any suggestions leading to improvements in the content or presentation of the course, especially in the laboratory work, are most welcome.