

Eastern Kentucky University
Department of Technology

Syllabus for EET 440-001, Fiber-optics & Communications, 10773
3 credit hours
Fall 2009

Instructor:

Prof. Vigs Chandra, PhD

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Class schedule:

Section 001, CRN 10773; MW: 12:20 p.m.-2.15 p.m., in Room 407/400

Office Hours:

MTWR: 9:30 a.m.-11 am, and 4:30 p.m.-6 p.m. If my office door is open at other times I will most likely be available for discussion. Come right in. You may email me regarding additional meeting times if needed.

CATALOG 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. 2 Lec/2 Lab.

Prerequisite:

MAT 108 (Trigonometry) or higher, EET 251 (Electricity and Electronics) and EET 257 (Circuits & Electronic Devices).

TEXTS:

Required:

Hecht, Jeff (2005). *Understanding Fiber Optics* (5th ed.). Upper Saddle River & New Jersey: Prentice Hall. ISBN: 0131174290 or 0130278289 (4th ed.).

Recommended:

Goff, David (2002). *Fiber Optic Reference Guide* (3rd ed.). Boston & MA: Focal Press. ISBN: 0240804864, or 0240803604 (2nd edition).

STUDENT LEARNING OUTCOMES:

Upon successful completion of this course the student will be able to:

1. Maintain proper safety precautions while handling and troubleshooting fiber-optic and other communication systems.
2. Integrate analog and digital electronic devices for creating a communication system.
3. Explain and illustrate the principles of light propagation, stimulated emission and absorption.
4. Evaluate the performance of various fiber-optic communication components – cables, sources, transmitters, receivers, connectors, couplers, switches.
5. Implement electronic circuits for fiber-optic based communication.
6. Design fiber-optic systems for sustaining a given data-rate based on transmission losses and budgeting of power.
7. Analyze the operation of different computer network configurations and optical networks using the simulation software OPNET[®].

COURSE OUTLINE:

1. Principles of communications (Week 1-3)
 - a. Electronic communication systems
 - b. The electromagnetic spectrum: audio frequency (AF), radio frequency (RF) and light
 - c. Transmission links and media
 - d. Analog, digital, and fiber-optic communications
 - e. Oscillators
 - f. Modulation types – amplitude, frequency
 - g. Filter circuits
2. Fiber-optics communication principles (Week 4)
 - a. Use of fibers in communications
 - b. Basic fiber concepts
 - c. Emerging optical networks
 - d. Basics of optics, light guiding and optical components
3. Fiber-optic measurements and test equipment (Week 5-6)
 - a. Optical power, wavelength and frequency measurement
 - b. Phase, interference and polarization measurements
 - c. Time, bandwidth, signal quality measurements
 - d. Instruments used in fiber-optic troubleshooting
5. Optical fibers – types, properties, materials, manufacturing, cabling (Week 7)
 - a. Light guiding
 - b. Use of different modes of fiber in communications
 - c. Materials and processes used in making optical fibers
 - d. Special purpose fibers
 - e. Cabling
6. Connectors, splices and couplers (Week 8)
 - a. Internal reflections
 - b. Signal attenuation
 - c. Connectors – structures, installation, types
 - d. Splicing
 - e. Coupler types, technologies

7. Light Sources (Week 9)
 - a. LED and laser sources
 - b. Types of lasers
 - c. Safety precautions while handling lasers
 - d. Optical amplifiers

8. Optical transmission and reception (Week 10-12)
 - a. Transmitters
 - b. Using multiple optical sources – wave division multiplexing (WDM), optical switching
 - c. Modulation principles
 - d. Detector basics
 - e. Sample transmitter and receiver circuits
 - f. Signal degradation, use of repeaters, regenerators and amplifiers

9. Optical networks, system standards, networking design (Week 13)
 - a. Evolving networks and telecommunications structure
 - b. Transmission topologies, formats, capacities
 - c. Fiber transmission, and optical networking standards
 - d. Use of WDM, switching, amplification in optical network design

10. Global, regional and local communications (Time permitting, Week 14-16)
 - a. Global networks – joining networks, terrestrial and long-distance systems
 - b. Regional networks – design of regional and metropolitan networks
 - c. Local networks – emerging services, passive networks, Gigabit Ethernet and Internet protocols, computer and phone networks, types of communications links
 - d. Cable television networks – digital and cable systems
 - e. Mobile communications – cellular networks, robotic vehicles, aircraft systems
 - f. Automatic identification systems

EVALUATION METHODS:

Each student will be evaluated as follows:

- Assessments (40%) – 3 assessments, including a final
- Lab assignments (30%) – between 10-15 labs, including simulations
- Paragraphs (10%) – 5 (approx.), paragraph on selected topics every 2-3 weeks paragraphs on various topics related to fiber-optic and electronic communications
- Fiber-optic technology design project – demonstration and write up (15%)
- In-class assignments (5%)

Field-trip to Time-Warner Cable/Whalin Technology Complex – attendance and report required. It will count as 1 lab activity.

1st assessment – (in-class, objective/short answer format, with 1 page, one side, 8.5x11 in. of notes permitted), covering class notes, labs, assignments, and selected material from chapters 1 – 6, parts of 17 & 18. To be held during the 6th week (Sept. 28-30) of the semester.

2nd assessment – (in-class, objective/short answer format, 1 page, both sides, 8.5 x 11 in., of notes permitted), tentatively covering class notes, labs, assignments, and selected material from chapters 7 – 14. To be held during 12th week (Nov. 9-13) of the semester.

The in-class assignments will be based on discussions and group activities. Reduced credit will be awarded for any missed in-class assignments which are completed at a later date, unless it was due to an excused absence. Regular attendance in class is the best way to ensure that students get full credit for this section.

Final Assessment – (in-class, objective/short answer format, open-book and notes), **Comprehensive**, covering class notes, labs, assignments, and selected material from chapters 1 – 22 of the textbook. To be held between 10:30 a.m.-12:30 p.m., Wed., Dec. 16, 2009. 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.

The EET440 class portfolio will be useful in organizing your learning – maintain separate sections for notes, laboratory activities, assignments, paragraphs, assessments, and reference materials. The portfolio is to be brought in at the time of the final for evaluation.

Paragraphs: Paragraphs related to selected topics in fiber-optics and communication technologies being discussed in the class, are to be submitted every 2-3 weeks. These should and cover advances in the field of networking and be taken from a recent (2005 onwards) computer related magazine, preferably conference paper, or internet web site. Summarize in your own words the main points of the articles, what you found most interesting, and indicate how it relates to class discussions or laboratory activities. Students will be invited to share their findings with the rest of the class. Complete references about the article on which the paragraph is based should be provided, including information about when it was retrieved from the web, and preferably a copy of the article itself. The reference should also include a persistent link to the article when possible. The references should be formatted using American Psychological Association (APA) guidelines, which are available at <http://nutsandbolts.washcoll.edu/apa.html>. Refer to the Academic Search Premier Database (<http://www.library.eku.edu/new/index.php>) which is available for both on- and off-campus use through the ECU libraries, for identifying suitable technical articles. An online video tutorial on retrieving articles through the ECU library databases is available at: <http://www.people.eku.edu/chandrav/Ref/onlineArticlesEKU.wmv>.

Design project and presentation: You may choose to work by yourself or in groups of up to three persons on the project. Design and build or simulate a communication/control system application that includes optical or radio frequency data transmission and reception. For identifying your project topic research articles of interest in the area of communications technology, amateur radio, networking of computer systems especially those using fiber optic components. Other options include comparative studies of fiber vs. different types of media used in networks, industrial applications, the design of computer networks using OPNET[®], or implementing a small scale fiber-optic computer interfaced communication system. A demonstration of your work is required, along with detailed individual or group written project report, approximately 5-7 pages in length (excluding title page, references and appendices). Use appropriate bibliographical references in APA format.

The project report should contain:

- Title page – project title, name, course, date, department, and institution
- Table of contents – include page numbers for various sections of the report
- A one paragraph summary or abstract of the whole report

- Introduction/background section with motivation for the project, and the relevant theory on which it is based - include applications from industry where similar ideas are being used or which prompted your design; also list alternate designs your group discussed, emphasizing the design which was finally chosen. Use APA citation for references used indicating the ideas which influenced your project.
- Problem statement section – explain the issue you are trying to solve. Include the precise conditions under which your design is supposed to function ('in-scope' specifications).
- Design section - include your suggested final design with detailed illustrations, circuit diagrams, and the principle of operation of the system. It should also contain a block diagram of your system showing how the different parts of the system are linked together. The design section may contain subsections for the major blocks or tasks that need to be completed. Designate key tasks as project milestones, and include a schedule for the different tasks, along with the group member(s) assigned to the task, and the resources needed.
- Implementation section – indicate whether the completed project meets and/or exceeds the in-scope specifications the project. Record any specific troubleshooting steps which were needed. Which part of the design was the hardest and which how closely did your actual implementation follow the schedule. Include a subsection for operational testing, with the procedures used to determine whether it conforms to the in-scope specifications. If needed include a subsection on simulation and calculated results, along with any graphs or tables showing the trends observed. Include digital photograph(s) of the operational project.
- Conclusions section – summarize the status of the project. Note the significance of the project. If possible compare it to similar commercially available systems. Are there any key findings or implications which can be useful in extending its functionality.
- References section - list at least 3 references in APA format. These should be articles or books relevant to your project.
- Appendices - include step-by-step operating instructions, program code, or manufacturer specification sheets, list of the materials and equipment used along with costs. Label the appendices A, B, etc.

Course Requirements:

Students are expected to:

1. Attend each lecture and laboratory session.
2. Complete all in-class assignments
3. Complete assigned laboratory, simulations and paragraphs as prescribed by the instructor.
4. Complete the assessments covering material from the assignments, labs, classroom discussions, and assigned readings in the text.
5. Maintain a 3-ring binder or folder for organizing class and reference materials

Grades:

100-90%	=	A	69.9-60%	=	D
89.9-80%	=	B	Below 60%	=	F
79.9-70%	=	C			

Mid-term grades will be made available to students by Friday, Oct. 16, 2009.

Tuesday, Dec. 22, 2009 – Final grades available online

STUDENT PROGRESS:

Students will be informed of their progress in the course after the 1st assessment (approximately 6th week of the semester). All students are encouraged to meet with me and discuss their and identify opportunities for improvement at any time during the semester.

Sunday, Aug. 30, 2009 – End of Add/Drop period: Last day to drop a full semester course without a "W" appearing on the university transcript, last day to register for or add additional full-semester courses. Last day to convert "Pass/Fail" or "Audit" classes to a normal grade and credit option. Completed forms must be returned to: Registrar's Office (SSB 239), or Corbin, Danville, or Manchester centers.

Friday, Sep. 11, 2009 – Last day to convert a class from credit with normal grade to "Pass/Fail" or "Audit". Completed forms must be returned to: Registrar's Office (SSB 239), or Corbin, Danville, or Manchester centers.

Last Day to Drop the Course: Friday, Oct. 30, 2009 – Last day to withdraw with a "W" from a full-semester class, or to withdraw from full-semester classes or withdraw from the university.

ATTENDANCE POLICY:

Regular attendance is needed for students in order to successfully complete the course. After the second unexcused absence, each unexcused absence will cause two 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. If you have a university accepted excused absence, make-up work is permitted with no penalty. 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. You will benefit most by way of understanding the content of the course by completing all the assigned work in a timely manner. If you know in advance that you will be absent, please inform me at the earliest. Email is usually the fastest way of contacting me.

Field-trip:

A field-trip is planned during November to either Time-Warner Cable, Richmond, KY, or of the Whalin Technology Complex, for examining the telecommunication network infrastructure. Attendance is encouraged, and a write-up on the field trip is part of the grade for the class.

Cell Phones:

Cellular phones should be off or on silent ring during class in order to keep classroom distractions at a minimum. Under special circumstances students are permitted to use the phone but should seek my approval prior to class.

DISABILITY STATEMENT:

If you are registered with the Office of Services for Individuals with Disabilities, please obtain your accommodation letters from the OSID and present them to the course instructor to discuss any academic accommodations you need. If you believe you need accommodation and are not registered with the OSID, please contact the Office in the Student Services Building Room 361 by email at disserv@eku.edu or by telephone at (859) 622-2933 V/TDD. Upon individual request, this syllabus can be made available in an alternative format.

ACADEMIC INTEGRITY STATEMENT:

Students are advised that EKU's Academic Integrity policy will strictly be enforced in this course. The Academic Integrity policy is available at www.academicintegrity.eku.edu. Questions regarding the policy may be directed to the Office of Academic Integrity.

OFFICIAL E-MAIL:

An official EKU e-mail is established for each registered student, each faculty member, and each staff member. All university communications sent via e-mail will be sent to this EKU e-mail address.

☺ 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 class 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.

EKU will develop informed, critical & creative thinkers who communicate effectively.

(EKU Quality Enhancement Plan, 2009)