

# **COURSE SYLLABUS OSE 4470 FALL 2014 'FIBER-OPTIC COMMUNICATIONS'**

**INSTRUCTOR: SASAN FATHPOUR**

CLASS DAY AND TIME: TUESDAYS, THURSDAYS 3:00 PM TO 4:15 PM; ROOM: 103  
OFFICE HOUR: TUESDAYS 2:00 PM TO 3:00 PM; ROOM: A214

**CREDITS:** 3 Hours

## **CATALOG DESCRIPTION**

Introduction to the principles and design of optical fiber communication systems including the optoelectronic devices used in transmitters and receivers.

## **COURSE DESCRIPTION**

This course is an introduction to the principles of optical fiber communication systems. The course covers three topics: 1) The optical fiber as a transmission channel. 2) Optoelectronic devices used in transmitters, receivers, and multiplexers. 3) Design of the overall communication system and assessment of its performance. In part 1, step-index and graded-index multimode and single-mode optical fibers are described and their attenuation and dispersion characteristics are determined. The transfer function of the fiber system is determined. Part 2 introduces the basic principles of interaction of light with semiconductor materials, including absorption and electroluminescence. Light emitting diodes, laser diodes, and photodiodes are introduced as the basic components of optical transmitters and receivers. Semiconductor and fiber optical amplifiers are also introduced. Part 3 deals with the design of the digital fiber communication system, including derivation of the bit error rates for attenuation- and dispersion-limited systems and determination of the maximum data rates possible for a given length. Introductions to wavelength-division multiplexing (WDM) and optical fiber networks are also provided.

**PREREQUISITE:** OSE 3052 Introduction to Photonics

## **LIST OF TOPICS:**

1. The fiber as a communication link:
  - Planar optical waveguides. Waveguide modes.
  - Step- and graded-index optical fibers. Multimode and single mode fibers.
  - Attenuation. Material and modal dispersion
  - Broadening of optical pulses in fibers
2. Optoelectronics of transmitters and receivers:
  - Interaction of light with semiconductor materials. Absorption and electroluminescence.
  - Optoelectronics: Semiconductor light sources (Light emitting diodes and laser diodes) and photodetectors (PIN photodiodes and avalanche photodiodes)
  - Semiconductor and fiber optical amplifiers
3. The communication system

- Digital fiber communication systems. Bit error rates for attenuation- and dispersion-limited systems.
- Maximum data rates achievable for a given fiber length.
- Wavelength-division multiplexing (WDM).
- Optical fiber networks

### **LEARNING OUTCOMES:**

Upon completing this course, the students will:

- Understand how optical fibers guide light, including the concepts of guided modes and group velocity.
- Know how to compute the attenuation and pulse broadening encountered when optical pulses at a given wavelength travel in long fibers.
- Know the operational principles of light emitting diodes and laser diodes and their distinction
- Know the operational principles and the limitations of photodiodes and avalanche photodiodes
- Understand the basics of optical modulation and multiplexing
- Be able to design a fiber link of given length operating at a given wavelength, and at a prescribed bit error rate by use of optical repeaters
- Acquire an integrated view of engineering by seeing the fundamental analogies between electrical and optical communication systems

### **REFERENCES:**

#### **Required Textbook:**

- *Optical Fiber Communications*, 4th Edition G. Keiser, McGraw-Hill

#### **Suggested Textbooks:**

- *Introduction to Optical Fiber Communication Systems*, W. Jones, Jr., Oxford University Press.
- *Fiber-Optic Communication Systems*, G. Agrawal, Wiley.
- *Fundamentals of Photonics*, 2nd Edition, B. Saleh and M. Teich, Wiley.

### **ASSESSMENT**

- Homework (25%): Assigned on Tuesdays and collected in class the next Tuesday
- Two Midterm exams (20% each): **Sept. 23 and Oct. 28** (in class)
- Comprehensive final exam (35%): According to UCF Exam Calendar

### **COURSE WEBSITE**

Visit <https://webcourses.ucf.edu/> for homework assignments and solutions

### **CHAPTERS COVERED FROM THE REQUIRED TEXTBOOK**

Chapters 1- 8 and 10 of Keiser's textbook are covered. However, the brief review of Chapter 10 is complementary and will not be part of exams. Also, the following Sections from Chapters 1 through 8 are not covered and will not be part of exams:

**Excluded Book Sections:** 1.7, 1.8, 2.8, 2.10, 3.4, 4.4, 4.5, 4.6, 4.7, 5.4, 5.6.3, 6.4, 6.6, 7.5, 8.2.4, 8.2.5, 8.2.7, 8.3, 8.4, and 8.5.

### **University Rules on Professionalism and Ethics**

Per university policy and plain classroom etiquette, mobile phones, etc. must be silenced during all classroom lectures, unless you are specifically asked to make use of such devices for certain activities.

Academic dishonesty in any form will not be tolerated. If you are uncertain as to what constitutes academic dishonesty, please consult The Golden Rule, the University of Central Florida's Student Handbook (<http://www.goldenrule.sdes.ucf.edu/>) for further details. As in all University courses, The Golden Rule Rules of Conduct will be applied. Violations of these rules will result in a record of the infraction being placed in your file and the student receiving a zero on the work in question at a minimum. At the instructor's discretion, you may also receive a failing grade for the course. Confirmation of such incidents can also result in expulsion from the University.

### **Students with Special Testing/Learning Needs**

Students with special needs and require special accommodations must be registered with UCF Student Disability Services prior to receiving those accommodations. Students must have documented disabilities requiring the special accommodations and must meet with the instructor to discuss the special needs as early as possible in the first week of classes. UCF Student Disability Services can be contacted at <http://www.sds.sdes.ucf.edu/>, or at (407)823-2371.

### **Academic Ethics Specific to This Lab Course**

It is the nature of a laboratory course that you will be working in groups. Obviously, those of you who are lab partners will be using the same raw data. You are encouraged to discuss your observations and insights with your lab partners; however, each of you has to write your own ORIGINAL lab reports.

Cheating and plagiarism are serious breaches of the UCF Code of Honor as described in the UCF Golden Rule and the UCF Creed, and will not be tolerated in this course. All cases will be reported to the Office of Student Conduct (OSC).

### **Definitions**

***Cheating:*** any unauthorized assistance in graded, for-credit assignments.

***Plagiarism:*** appropriating the work of others and claiming, implicitly or explicitly, intentionally or unintentionally, that it is your own.

With increased use of the internet, digital plagiarism is becoming more of a problem on campuses everywhere. You are encouraged to use the internet; however, electronic copying and pasting of material directly into reports and papers without proper reference of the source is blatant plagiarism. **Always reference the sources of information.**

**Providing a fellow student with experimental data from an experiment in which he/she did not participate is also forbidden. All parties that are involved in such practice will be reported to UCF Office of Student Conduct (OSC).**

If there is any question concerning acceptable practice in this laboratory course, do not hesitate to ask the instructor.