OSE6474 Fundamentals of Optical Fiber Communications

CREOL-The College of Optics and Photonics

SPRING 2021 COURSE SYLLABUS

Instructor:	Demetrios Christodoulides	Term:	Spring 2021
Office:	CREOL 210	Class Meeting Days:	Mon-Wed.
Phone:	407 882 0074	Class Meeting Hours:	1:30-2:45 PM
E-Mail:	demetri@creol.ucf.edu	Class Location:	Zoom
Website:	NA	Lab Location:	NA
Office Hours:	Monday-Wednesday 12:00-1:00		

I. Welcome!

NA

II. University Course Catalog Description

Introduces key principles and analysis of optical communication systems. Emphasis on developing the ability to

analyze and design digital, analog fiber-based systems and networks

III. Course Overview

The course will cover the physical layer associated with fiber optic networks. Topics include optical fibers, detectors/receivers and noise characteristics, optical sources like semiconductor lasers and LEDs as well as optical amplifiers and other fiber-based components.

IV. Course Objectives

This course will aim at elucidating the key principles underlying the analysis of optical communication systems based on their fiber- and optoelectronic-based components. The emphasis will on engineering aspects and the students should be able to comprehend, analyze and design digital and analog fiber-based systems and networks.

In order to analyze and design fiber-optic systems, it is necessary to study the components that constitute it, the principles that underlie their operation, and their functional characteristics from the perspective of a system design engineer. To this extent, the course will develop tools to understand:

- Propagation of signals and their impairments in optical fibers
- Operational characteristics of optical transmitters and receivers
- Link analysis of digital and analog optical systems
- Dispersion management techniques

V. Course Prerequisites

Graduate Standing; OSE6111 "Optical Wave Propagation"

VI. Topics to be covered during this course

1. Overview of fiber optic communication systems

2. Propagation of signals in fibers

- Multimode fiber: ray analysis, graded-index fibers, bandwidth, modal noise
- Single-mode fibers: pulse propagation, group velocity dispersion, polarization-mode dispersion (PMD), optical dispersion compensation techniques.
- Fiber fabrication techniques
- Nonlinear effects in fibers
- Planar slab waveguides
- Waveguide modes, field distribution, and group velocity

3. System performance of telecom lasers

- Operation principles, modulation, chirp, linewidth enhancement factor, phase and intensity noise characteristics

4. Optical receivers

- Noise (Shot and thermal noise sources and PIN vs. APD)
- Sensitivity (Bit-error rate, minimum received power, quantum limit of detection)
- Sensitivity degradation (extinction ratio, intensity noise, timing jitter)

5. Optical modulators

- Electro-optic modulators
- Electro-absorption modulators
- Acousto-optic modulators

6. Optical amplifiers

- Erbium doped fiber amplifiers (EDFAs): gain spectrum and bandwidth, gain saturation and amplifier noise
- Semiconductor optical amplifiers(SOAs): basic design and characteristics

7. Optical communication systems

- Loss- and dispersion-limited systems
- Power and rise time budget

- System architectures (point-to-point, distributed and local area networks)
- Long-haul digital link design (sources of power penalty: modal noise, dispersive pulse broadening, mode partition noise, frequency chirping and reflection feedback)
- WDM systems
- Dispersion management
- Dispersion-compensating fibers
- Fiber Bragg gratings

8. Coherent optical systems

- Homodyne and heterodyne detectors
- Modulation formats (ASK, PSK and FSK)

VII. Course Credits

3 credits

VIII. Required Texts and Materials

Fiber Optic Communication Systems, 3rd Edition, G. P. Agrawal, John Wiley and Sons, 2002.

IX. Supplementary (Optional) Texts and Materials

1) Optical Fiber Communications: Principles and Practice, 3rd Edition, John M. Senior, Prentice Hall, 2009.

2) Fundamentals of Optical Waveguides, 2nd Edition, K. Okamoto, Academic Press, 2006.

3) Optical Networks, 2nd Edition, R. Ramaswami and K. Sivarajan, Morgan Kaufmann, Elsevier, 2010.

X. Basis for Final Grade

Provide a listing of assessments and their weighting in the semester total. In addition to (or even in lieu of) tests, consider exploring "authentic" assessments, which are based as closely as possible to real world experiences.

Assessment	Percent of Final Grade
Homework	20%
Midterm #1	25%
Midterm#2	25%
Final Exam	30%
	100%

Insert grading scale (with plus/minus scaling, if applicable) here. We have provided templates for your grading scale, including one for plus/minus grading, and the general grading scale. Feel free to use either one of these, adjusted for your own grading scale, if different:

Grading Scale (%)	
94-100	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
74-79	C+
65-73	C
60-64	C-
55-59	D+
53-54	D
50-52	D-
0 - 49	F

XI. Grade Dissemination

Homework, graded mid-term tests will be returned to the students. The final exam can be discussed with the student upon request.

XII. Course Policies: Grades

Late Work Policy: There are no make-ups for in-class presentations, quizzes, the midterm, or the final exam.

Extra Credit Policy: NA

Grades of "Incomplete": Offer specifics about your policy on incomplete grades.

The current university policy concerning incomplete grades will be followed in this course. Incomplete grades are given only in situations where unexpected emergencies prevent a student from completing the course and the remaining work can be completed the next semester. Your

instructor is the final authority on whether you qualify for an incomplete. Incomplete work must be finished by the end of the subsequent semester or the "I" will automatically be recorded as an "F" on your transcript.

Rewrite Policy: NA

Essay Commentary Policy: NA

Group Work Policy: NA

XIII. Course Policies: Student Expectations

Disability Access: Offer specifics about the UCF policy on disability access.

The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. This syllabus is available in alternate formats upon request. Students who need accommodations must be registered with Student Disability Services, Ferrell Commons Room 185, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

Attendance Policy:

Students are expected to attend the lectures.

Professionalism Policy:

Per university policy and classroom etiquette; mobile phones, iPods, *etc*. must be silenced during all classroom lectures. Those not heeding this rule will be asked to leave the classroom/lab immediately so as to not disrupt the learning environment. Please arrive on time for all class meetings. Students who habitually disturb the class by talking, arriving late, *etc*., and have been warned may suffer a reduction in their final class grade.

Academic Conduct Policy:

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 receiving a zero on the work in question. 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