OSE6474: Optical Communications Systems

CREOL

The College of Optics and Photonics, University of Central Florida

COURSE SYLLABUS

Instructor:	Dr. Demetrios Christodoulides	Term:	Spring 2017
Office:	CREOL 210	Class Meeting Days:	T, Thu
Phone:	407-882-0074	Class Meeting Hours:	3:00PM - 4:15 PM
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Office Hours:	By appointment		

I. 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

II. 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 at the end of the course.

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

III. Course Prerequisites

Graduate Standing; OSE5414 (Fundamentals of Optoelectronic Devices) Recommended

IV. Course Credits

3

V. Required Texts and Materials

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

VI. Supplementary (Optional) Texts and Materials

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

2) *An Introduction to Fiber Optics*, A. K. Ghatak and K. Thyagarajan, Cambridge University Press, 1998.

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

VII. 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%

Grading Scale (%)	
94-100	A
90-93	A-
87-89	B+
84-86	B
80-83	B-
77-79	C+
74-76	C
70-73	C-
67-69	D+
64-66	D
60-63	D-
0 - 59	F

VIII. Topics to be covered in this course:

1. **Overview of fiber optic communication systems**

2. **Propagation of signals in fibers**
    1. Multimode fiber: Ray analysis, Graded-Index Fibers, Bandwidth, Modal noise
    2. Single-mode fiber: Pulse propagation, Group velocity dispersion, Polarization-mode dispersion (PMD), Optical dispersion compensation techniques.
    3. Fiber fabrication techniques
    4. Nonlinear effects in fibers

    1. Planar slab waveguides
    2. Waveguide modes, field distribution, and group velocity
    3. Rectangular channel

3. **System performance of telecom lasers**
    1. Operation principles, modulation, chirp, linewidth enhancement factor, phase and intensity noise characteristics

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

5. **Optical modulators**
    1. Electro-optic modulators
    2. Electro-absorption modulators

6. **Optical amplifiers**
    1. Erbium Doped Fiber Amplifiers (EDFA): gain spectrum and bandwidth, gain saturation and amplifier noise
    2. Semiconductor Optical Amplifiers (SOA): basic design and characteristics

7. **Optical communication systems**
    1. Loss- and dispersion-limited systems
    2. Power and rise time budgeting
    3. System Architectures (point-to-point, distributed and local area networks)
    4. Long-haul digital link design (sources of power penalty: modal noise, dispersive pulse broadening, mode-partition noise, frequency chirping and reflection feedback)
    5. Analog optical link design and CATV systems
    6. WDM systems

8. **Dispersion management**
    1. Precompensation techniques (prechirp, novel coding and nonlinear prechirp)
    2. Postcompensation techniques
    3. Dispersion-compensating fibers
    4. Fiber Bragg gratings

9. **Coherent optical systems**
    1. Homodyne and heterodyne detectors
    2. Modulation formats (ASK, PSK and FSK)

IX. Course Policies: Grades

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

Grades of "Incomplete: 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.

X. Course Policies: Student Expectations

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: Class attendance is required in this course.

Professionalism Policy:
Per university policy and classroom etiquette; mobile phones, iPods, *etc*. **must be silenced** during all classroom and lab 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 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.

University Writing Center: The University Writing Center (UWC) is a free resource for UCF undergraduates and graduates. At the UWC, a trained writing consultant will work individually with you on anything you're writing (in or out of class), at any point in the writing process from brainstorming to editing. Appointments are recommended, but not required. For more information or to make an appointment, visit the UWC website at http://www.uwc.ucf.edu, stop by MOD 608, or call 407.823.2197.