ECE 6323
Optical Communications: Principles and Practices
Syllabus

http://courses.egr.uh.edu/ECE/ECE6323/Web/welcome.html

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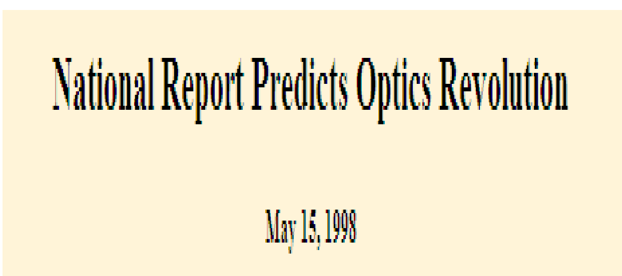
Office Hours: See course Web page, and by appointment

GENERAL INFORMATION
Catalog Description: Prerequisite: Consent of instructor (*a strong background of undergraduate physics, optics, microelectronics is essential*). Devices and systems in optical fiber communications: fiber dispersion and attenuation, fiber solitons, photodiodes, fiber amplifiers, SONET/SDH transport systems, and present and future multi-wavelength networks.

Course Background Note: In a 1998 report, the Committee on Optical Science and Engineering (COSE) for the 21st Century commissioned by the National Research Council predicted the pending arrival of the optics revolution.



The report was indeed prescient and timely, as 1998-2001 witnessed a quantum jump in the IT industrial revolution. The popularization of the much-heralded Internet and information superhighway in early 90's led to an exponential demand for communication bandwidth that strained the copper- and microwave-based network. Market necessity led to the full embrace of the opto-centric technology paradigm, in which optics became ***the*** enabling technology. The global liberalization of the telecom industry subsequently triggered an unprecedented worldwide expansion of telecommunication fiber-optic network with trillions-of-dollars capital spent to lay down millions of fiber-mile around the globe.

Today, much of the promise of the Optical Internet has been delivered as the world enjoys wireless mobile computing everywhere that runs on the vast fiber optics networks that reach every corner of the globe. The technology continues to evolve, improve, addresses new applications and demands from cloud computing to green energy and resources management. The revolution that started at the core with high-bandwidth trunking and switching is now moving to the edge with optical access networks for fiber to the premise (FTTP) or to the home (FTTH), changing the way we live and work.

Course Objectives:

This course aims to give 1st & 2nd year graduate student an introductory but thorough and comprehensive perspective of optical communications. It is designed for breadth rather than depth, aiming to give students the "big" picture, i. e. the forest rather than the trees. The emphasis will be on more on conceptual understanding rather than detailed physical science and engineering, although the latter is essential for any student interested in further study of the topics.

Course Topics:

The course will cover the following areas and topics (listed in logical grouping, not chronological order)

1. The world of optical communication: historical perspective; business perspective; voice service and data service; network evolution and the Internet; deregulation trends and market-driven broadband convergence; the information-based economy.
2. Communication system and network: concepts and overview; the physical process and logical representation of communications; network basic: network protocol and architecture, the 7-layer OSI network model; typical network topology; local, metro & regional, long-haul and ultra-long-haul; Ethernet, SONET, ATM, FR; wavelength routing; access network and GPON.
3. Physical layer: optical communication phenomena, system and network: fiber and optical transmission; advanced fiber design (inc. holey fiber); dispersion effects (modal, material chromatic) and compensation, polarization effects (PMD) and compensation, nonlinearities (SBS, SPM, CPM, 4-wave mixing, solitons); system design: high-bit-rate transmission systems; lightwave systems and network
4. Optics/photonics enabling technologies: fundamentals of lightwave engineering: optics, quantum electronics, optoelectronic materials, fabrication, and basic device technology. The optical network enabling technology: transmission technology, source & signal generation: laser transmitter, modulator, isolator, circulator; receiver; signal transmission: fiber, dispersion management, nonlinear effects; signal conditioners and 3R/4R: amplifiers (EDFA, SOA), dispersion compensation; network element technology: (D)WDM technology: gratings, filters, passive and active devices; signal processors; gain equalizer, power splitter, combiner, coupler, optical switching and routing: space, time, and wavelength granularity, add/drop mux, advanced optical signal processing functions of photonic integrated circuits. Integrated photonic circuit modules.
5. Advanced topics: the future of optical network: advanced architecture; GMPLS; optical burst switching, novel and disruptive component technology; layer-2 and layer-3 enabling technology for optical bandwidth provisioning, optical packet switching; optical Ethernet; access network and passive optical networks.

It is impractical to cover this field to any significant depth with one 3-cr semester, it is expected that the interested student should follow up with readings and related courses that treat more in depth on the optical science and technology aspects of the field.

Required Text: None but see below for recommended texts.

Recommended Materials for Supplementary Self-Study: The following can be used as textbooks or references:

- Optical Fiber Communications: Principles and Practice (3rd Edition), John Senior, Prentice Hall (2008).
- Fiber-Optic Communication Systems, Govind P. Agrawal, Wiley-Interscience; 3rd Ed. (2002).
- Optical Fiber Telecommunications, IIIA and IIIB, I. P. Kaminow and T. L. Koch (Editors), Academic Press (1997).
- Fiber Optics Handbook: Fiber, Devices, and Systems for Optical Communications, Optical Society of America, McGraw-Hill Professional (2001).

Introductory level textbooks for review:

- Fiber Optic Communications (5th Ed.), Joseph C. Palais, Prentice Hall (2004).
- Optical Communications Essentials, Gerd Keiser, McGraw-Hill Professional (2003).

Expected Course Outcomes:

Outcome 1: To give each student a solid knowledge-base in the fundamentals of mathematics and basic science (optics, fiber-optics, optical communications, optoelectronics and photonics).

Outcome 2: To develop in each student the basic skills of problem solving and critical thinking.

Outcome 3: To give each student knowledge of contemporary issues that relate to engineering.

Academic Honesty Policy:

Students in this course are expected to follow the Academic Honesty Policy of the University of Houston. It is your responsibility to know and follow this policy. You must sign the Academic Honesty Statement on the last page of this handout, detach it, and submit it by the 3rd or 4th class from the start of the semester. If you fail to do this, you may be dropped from the course.

E-mail Policy and Information:

The instructors will make major announcements on the course webpage in addition to those in the classes: http://courses.egr.uh.edu/ECE/ECE6323/Web/welcome.html

The announcements include information about quizzes, homework, lectures, and any other topics important to the class. You are responsible for checking the webpage daily to make sure that you are aware of the announcements.

The class e-mail is: *ece6323@gmail.com*. The Cullen College of Engineering adopts e-mail as its official channel for communication with students. The Cullen College of Engineering will use your UH e-mail alias as the primary means to contact you and keep you informed about college news. As a student at the University of Houston, you have been assigned a UH e-mail alias that points to the e-mail address you provided to the university when you applied for admissions (it is blank if you did not). E-mail messages addressed to your alias are automatically forwarded to your preferred e-mail account. For example, if you provided joecougar@aol.com to UH, any e-mail sent to your new alias will automatically be sent to joecougar@aol.com. UH will use your alias to send you important university information such as emergency closings or information from your faculty and department. Please make sure that your email alias points to an email account that you check regularly.

Evaluation of learning outcomes:

1. Homework (30-35%)
2. Course papers and projects (30-35%)
3. Exams and quizzes (30-35%)