**Usage 1997-99 Catalog Data:** Principles of optical fiber wave-guiding and losses; sources and detectors; receiver and transmission systems.

**Prerequisite:** ECE 3323, ECE 3623 and ECE 3813, or permission of instructor.


**References:** NA

**Prerequisites by Topic:** Introductory solid state devices, introductory electromagnetic field theory, introductory electronics.

**Topics:**

1. **Light Propagation**
   1. Fundamentals
   2. Snell's law, total internal reflection
   3. Maxwell's equations
   4. Wave equation

2. **Optical Waveguides**
   1. Dielectric slab waveguide
   2. Step-index fiber
   3. Graded-index fiber
   4. Signal degradation
   5. Fiber materials and fabrication

3. **Optical Sources**
   1. Light emission in semiconductors
   2. Light emitting diodes
   3. Semiconductor lasers

4. **Power Launching and Coupling**
   1. Source-to-fiber power launching
   2. Lensing schemes
   3. Connectors and splices

5. **Photodetectors**
   1. Principles
   2. PIN photodiodes
   3. Avalanche photodiodes

6. **Optical Receivers**
   1. Receiver operation
   2. Receiver performance
   3. Preamplifiers

7. **Fiber Communication Systems**
   1. Transmission link analysis
   2. SONET/SDH, FDDI, ATM
   3. LAN/WAN strategies
   4. Broadband services over fiber
   5. Wavelength-Division Multiplexing
   6. Analog systems
   7. Advanced systems & technologies (as time permits)

**Schedule:** MW 6:30-7:45 p.m.
Computer: Math packages, such as MATHCAD and MATLAB (students’ choice), and word processing.

Design Projects: See attached final examination.

Laboratory Projects: NA

Assessment Methods Used: Graded homework assignments, examinations, and a research project.

Contribution to Professional Component: Engineering Science 67%, Engineering Design 33%.

Program Objectives, Related Strategy, and Actions: 2. i, ii

ABET 2000 Criterion 3 Contents: a, b, c, e, g, k

Prepared by: J. Sluss    Date: May 20, 1999
ECE 5353 - Fiber Optics
Spring 1999

Final Exam

Instructions:
There is no time limit on this take-home final, except that it is due by Tuesday, May 4, 1999, by 5:00 p.m. **You may not discuss your solutions with others.** You may use any reference material available to you, however, your references should be cited. Clearly state and justify the use of any assumptions. Show all work for full credit.

On my honor as a student, I have neither given nor received aid on this exam.

V. Signature               _____________ Date

DESIGN PROBLEM
You have been given the job of designing an optical transceiver (transmitter plus receiver) for a point-to-point fiber link operating at 155 Mbps (SONET OC-3) over a distance of 45 miles. Your customer will provide single-mode fiber with attenuation of 0.4 dB/km @ 1310 nm and 0.25 dB/km @ 1550 nm. The fiber will be supplied in 6 km reels and the customer’s installation technicians typically achieve a splice loss of no worse than 0.1 dB/splice.

The telecommunications company you work for manufactures SONET multiplexers that operate at 155 Mbps. Your transceiver must interface with these multiplexers. An NRZ electrical signal will be handed off to your transceiver for transmission over a fiber. The signal is driven by the output of a CMOS integrated circuit. Your transceiver must also detect an incoming optical signal from a fiber and convert it to an electrical signal that will be handed off to the input of a CMOS integrated circuit.

Given your ultimate transceiver design, the customer seeks your recommendation regarding the necessity of using of dispersion-shifted or dispersion-flattened fiber. Link power budget and dispersion limitation calculations must be provided to support your recommendation.

*I am looking for a real design here, consisting of components whose performance is backed up by data sheets (please provide these as supporting information). The problem may not seem well defined to you, but this is what you can expect in industry. Part of your job is to fully define the problem before you solve it. You have a lot of freedom of choice here, as long as you can convince me that your choices are technically sound. Have fun and be brilliant!*