General Description

This course is designed to familiarize students with the physical properties of fiber optic components and systems. There will typically be two lectures/week during the scheduled class meeting times, and a total of eight lab experiments. I will also try to set up demonstration experiments for other topics not formally covered by an assigned lab. The lectures should provide sufficient background material for the lab experiments as well as a good foundation in fiber systems. During the first week of classes you should form a lab group of approximately three students, and decide on a meeting time. Check with the TA about available meeting times. Each lab experiment will be set up for approximately 8 class days. This will allow some time to repeat certain parts of a lab that you are unsure of or wish to check. There will be a final exam covering both lecture and lab material.

Prerequisites: No specific perquisites – some knowledge of EM and semiconductor devices will be helpful (check with instructor if in doubt)

* Note: For my office hours I will stay at OSC to answer questions immediately after class and then return to my office for additional questions if needed. Please e-mail me if you need to make a separate appointment time.

COURSE CREDIT

Undergraduates: Graduate Students
15% Homework: 15% Homework
45% Lab Reports: 45% Lab Reports
40% Final Exam: 40% Final Exam

GENERAL CLASS POLICIES:

University policies on withdrawals and incompletes will be followed. Please check the course schedule for important dates. Also please note University policies on academic integrity apply.

LAB REPORTS, HOMEWORK, and GRADING

Reports should be quantitative and concise. An acceptable format for a report should include the following:
1. Quiz (5%)
2. Experimental objectives – what is the purpose of the experiment and what do you hope to accomplish in the lab. (5%)
3. Experimental Setup- show a diagram of the experimental arrangement. (5%)
4. **Experimental DATA and Analysis** – List all experimental data recorded in a clear, easy to follow format. Indicate the error margin for your data and possible sources of error. (35%)

5. **Answers to the Experiment Questions** – there are several questions posed with each lab, answer all questions in a clear manner. (45%)

6. **Discussion and Summary** – Were the objectives accomplished? What difficulties were experienced? How were they dealt with? Please keep this quantitative and to the point. (5%)

Reports should be typed. Limit reports to the equivalent of five, single spaced typed pages. Longer reports are not necessary. Graphs should have the x- and y- axes clearly marked, and show the source of the plotted data. **Each person is required to turn in his or her own report.** They are due the first Monday after the last day that a lab is held. Each lab is worth 10 points: 1 day late, 5 points off; 2 days late, no credit. See me in advance if you think that you are having a scheduling problem – not after – so we can work something out. Homework is meant to be instructive and can lower or raise your average by one grade so it is worth doing. Homework is due in class on the date assigned. If turned in before the next class period it will only be worth half the original grade value, and no credit will be given after that. Again if you think that you’ll have a problem please see me before it is due. Please feel free to discuss material on labs and homework with other students, but please do your own write-ups and the details of your assignments on your own. The final exam is meant to test your overall understanding of the material covered in the experiments and in lecture. If you find discrepancies in the grading of your assignments please bring them to my attention within 2 weeks of their return. It is difficult for me or the TA to evaluate discrepancies long after the assignment was turned in.

Fiber optics is a rapidly growing technology with many applications. It is my intent to make this course a great learning experience. Hopefully at the end of this semester you will have acquired some valuable skills in this field.

**Distinction Between Undergraduate and Graduate Students**

Graduate students will be expected to answer all questions on homework assignments and lab handouts. Undergraduates need only answer designated sections. Graduate students and undergraduates will also have their grades computed separately.

**Course Content:**

**A. Lecture Topics**

1. Review of beam propagation characteristics in optical waveguides and fiber optic characteristics
2. Gaussian Beam propagation and transformation through optical systems
3. Summary of beam propagation characteristics in planar waveguides; even/odd modes; symmetric/asymmetric waveguides
4. Summary of beam propagation characteristics in cylindrical waveguides; Cut-off conditions; relative propagation constant; mode approximation for MM fibers; TE, TM; HE, EH; LP modes;
5. Power distributions in fiber core/cladding
6. Fiber properties: intro to dispersion; attenuation, OTDR measurements
7. Fiber coupling: fiber-fiber alignment; source fiber coupling, overlap integrals
8. Analysis and use of GRIN lenses in fiber optic systems
9. Properties of polarization preserving fibers
10. Detector characteristics
11. Receivers and noise
12. Laser diodes; threshold conditions; modes; modulation; noise characteristics
13. Optical transmitters: basic circuits, noise
14. System Analysis: Power Budgets; rise time budgets
15. WDM systems: crosstalk, channel separation, arrayed waveguide gratings
16. Fiber Bragg gratings, AWGs, Optical circulators analysis and applications
17. Digital Systems: SNR, BER, jitter, skew, evaluation using eye diagrams
18. Fiber amplifiers- Er doped fiber, Raman Amplifiers, Semiconductor Optical Amplifiers
19. Fiber optic sensors; intensity, interferometric, rotational
20. Optical coherence tomography systems
21. Fiber image guides, transmission of images through optical fibers

B. Laboratory Experiments
1. Basic Fiber Measurements: fiber preparation, NA measurements, and coupling
2. Single mode fiber coupling and mode distributions
3. Fiber Couplers
4. Laser diodes and fiber Bragg gratings
5. Wavelength multiplexing and de-multiplexing
6. Digital System Evaluation and Eye Diagram and Er Doped fiber amplifiers
7. Optical communication system simulator – system design and analysis
8. OCT fiber interferometer

Text: Notes will be posted on the class website (ece.arizona.edu/~ece487)
The following texts are recommended

Final Exam: 9 May 11:00-1:00