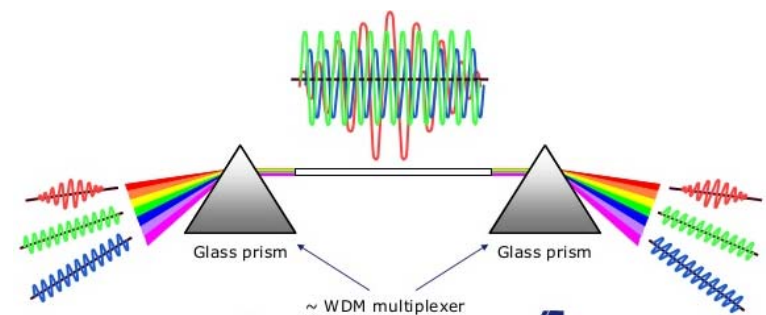
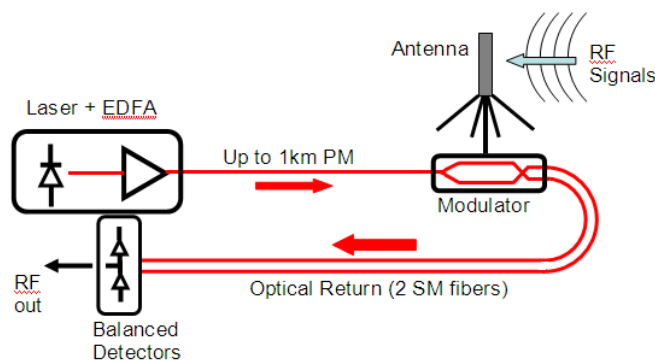
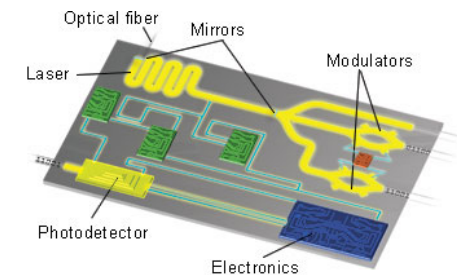
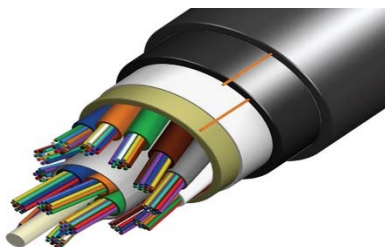
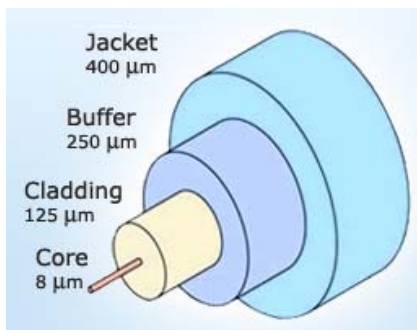
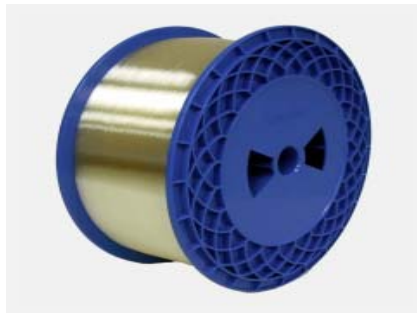


OSE 6474 Optical Communications Systems

Components and System Performance

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Physical Foundations:

- Electromagnetics
- Optoelectronics
(Phenomenological Description)

Part I Optical Transmission Channel: Waveguides and Fiber

- Review of basics (Maxwell's equations)
- Planar slab waveguides
- Waveguide modes, field distribution, and group velocity
- Single and multi-mode optical fibers
- Propagation constants and velocities
- Waveguide, material and modal dispersion

Part II Basic Components for Optical Communication

A. Source: Semiconductor Lasers

- Semiconductor lasers: rate equations and steady-state performance

B. Modulators:

- Direct modulation of semiconductor lasers: frequency response, intensity noise/linewidth
- Electro-optic modulators:
 - Linear electro-optic effect and phase modulation
 - Bulk and integrated EO modulators

Analysis Tools:

- Method of Perturbation
- Coupled-Mode Theory
- Fourier Analysis
- Statistical Analysis

C. Detectors

- Photodiodes; p-n and p-i-n hetero structure photodiodes
- Photodetector noise; thermal and shot noise
- Coherent detection

Part III Fiber-Optic Links

- Power budget and bandwidth budget
- Analog links (RF gain, Noise Figure and Dynamics Range)
- Digital Links (Gaussian BER estimation)
- Dispersion and pulse propagation in fiber
- Dispersion penalty

Part IV Multi-channel and Networking Components

- Intro to WDM
- Fiber couplers
- Fiber Bragg grating, WDM mux/demux
- Er-doped fiber amplifier (optional)

What You Will Learn

Lecture Schedule

- Lecture 1. Introduction
- Lecture 2. Review of EM
- Lecture 3. Planar Waveguide 1
- Lecture 4. Planar Waveguide 2
- Lecture 5. Optical Fiber (EM)
- Lecture 6. Fiber modes, dispersion, loss
- Lecture 7. Coupling light into fiber, Fiber manufacturing, fiber connectors
- Lecture 8. Semiconductor laser rate equations
- Lecture 9. Steady-state performance (LED vs. LD)
- Lecture 10. FP and DFB laser structures
- Lecture 11. Modulation characteristics of LD
- Lecture 12. Intensity noise and linewidth of LD
- Lecture 13. Electro-Optics
- Lecture 14. E-O modulator
- Lecture 15. Photodetectors (structures, basic characteristics)
- Lecture 16. Noises in photodetectors
- Lecture 17. Coherent detection
- Lecture 18. Power budget and bandwidth budget
- Lecture 19. Analog links
- Lecture 20. Digital links: Gaussian BER estimation
- Lecture 21. Pulse propagation in fiber
- Lecture 22. Dispersion penalty and dispersion compensation
- Lecture 23. Introduction to WDM
- Lecture 24. Coupled-mode equation, fiber coupler
- Lecture 25. Fiber Bragg grating as demultiplexers
- Lecture 26. EDFA (optional, depending on schedule)
- Lecture 27. EDFA (optional, , depending on schedule)

Textbook

- Fiber-Optic Communication Systems, 3rd Edition by [Govind P. Agrawal](#) (Wiley 2002)

Reading Materials

- Elements of Photonics by Keigo Iizuka (Wiley 2002)
- Principles and Applications of Optical Communications (Irwin 1999, out of print).

Grading

- Homework: 30%
- Midterms: 40%
- Final Exam: 25%
- Class Participation 5%

Office Hours on Demand