EECS 552: Optical Fiber Communications & Networks

Instructor: Professor Mohammed N. Islam

Prerequisites: EECS 538 or EECS 434 or permission of instructor

Class: Tuesday, Thursday 12noon-1:30pm
Office Hours: Wednesday 10:00-11:30

Grading: homework 25%, midterm 35%, term paper 40%

Homework policy: due in class on Thursday afternoon
solutions available on following Tuesday

Textbook:
M.M.K. Liu, "Principles and Applications of Optical Communications"
References: (on reserve in library)
I.P. Kaminow and T.L. Koch, "Optical Fiber Telecommunications III (A and B)"
J.M. Senior, "Optical Fiber Communications"
P.E. Green, "Fiber Optic Networks"
G. Keiser, "Optical Fiber Communications"
J. Gowar, "Optical Communication Systems"
C.R. Pollock, "Fundamentals of Optoelectronics"
G.P. Agrawal, "Nonlinear Fiber Optics"
G.P. Agrawal, "Fiber-Optic Communication Systems"
H.A. Haus, "Waves and Fields in Optoelectronics"
M.N. Islam, "Ultrafast Fiber Switching Devices & Systems"

Summary of Course

This course introduces students to the principles of fiber optical communications and networks. We start by covering the basics of point-to-point communication systems and shared medium networks. Propagation through single and multi-mode optical fibers is studied, including the effects of dispersion and attenuation. Nonlinearities in fibers such as self- and cross-phase modulation, Raman scattering and four-wave-mixing are discussed. Optical amplification based on erbium-doped fiber amplifiers and Raman amplifiers is described in detail. The nonlinear Schroedinger equation and fiber transmission systems based on solitons are also covered extensively. The last part of the course focuses on wavelength-division multiplexed fiber networks, IP networks, optical switching and optical switching cores for routing. Finally, we conclude with a discussion of future technologies for fiber optic networks.

Lectures (rough guideline)

Lay of the Land

Lecture 1	(1/7) Ch 1 Liu: General Introductory Discussion
Lectures 2	(1/9) Ch 2 Liu: From Point-to-Point to Networking

Fiber Optics

Lecture 3	(1/14) Ch 4 Liu: Propagation in Dielectric Waveguides
Lecture 4	(1/16) Ch 4 Liu: Material Dispersion in Fibers
Lecture 5	(1/21) Ch 4 Liu: Fiber Attenuation & Loss Limits
Lecture 6	(1/23) (notes): Electromagnetic Wave Propagation in Step-Index Fiber
Lecture 7	(1/28) Ch 4 Liu + notes: Total Dispersion & Limits, Single-mode Fibers
Lectures 8,9	(1/30, 2/4) (notes): Fiber Gratings

Nonlinear Effects in Fibers

Lecture 10	(2/6) (notes): Fiber Nonlinearities: SPM, XPM and SRS
Lecture 11	(2/11) (notes): Fiber Nonlinearities: 4WM, Parametric Amplification, Fabrication of Fibers
Lecture 12,13	(2/13, 2/18) (notes): Fiber Nonlinearities in Systems
Lecture 14	(2/20) (notes): Fiber Nonlinearities: Raman amplifiers and oscillators

Out-of-Class Exam # 1

Fiber Amplifiers for WDM Networks

Lecture 15	(3/4) Ch 17 Liu + notes: Noise in Amplification & Noise Figure
Lecture 16,17	(3/6, 3/11) Ch 17 Liu + notes: Erbium-doped Fiber Amplifiers

Raman Amplifiers and Systems

Lecture 18	(3/13) (notes): Raman Amplifiers for Telecommunications

Soliton Transmission Systems

Lecture 19	(3/18) Ch 18 Liu + notes: Nonlinear Schrodinger Eqn & Solitons
Lecture 20	(3/20) Ch 18 Liu + notes: Soliton RZ Transmission Systems

Optical Cross-Connects and MEMS Switching

Lectures 21,22	(3/25, 3/27) Ch 11 Liu + notes: Silicon Micromachines for networks

Wavelength Division Multiplexed Networks

Lectures 23,24	(4/1, 4/3) Ch 9 Liu + notes: WDM Optical Networks

Optical Switching and Routing

Lecture 25	(4/8) (notes) Optical Switching Cores for Routers
Lecture 26	(4/10) (notes) Future Technologies for Fiber Optic Networks

Final Exam in Class 4/15