FIBER OPTIC COMMUNICATION TECHNOLOGY

PROF. DEEPA VENKITESH
Department of Electrical Engineering
IIT Madras

PRE-REQUISITES : Signals and Systems

INTENDED AUDIENCE : Any interested learners

INDUSTRIES APPLICABLE TO : Sterlite Technologies Ltd., Tejas Networks, BSNL - other Telecom companies, BEL,

COURSE OUTLINE :
FOCT is a graduate level course, intended to expose the students to the physical layer elements and seamlessly provide a transition from the physical layer issues to data link layer issues in optical communication systems and networks.

ABOUT INSTRUCTOR :
Prof. Deepa Venkitesh received the Ph.D. degree from the Indian Institute of Technology Bombay, Mumbai, India, in 2009. She is currently an Associate Professor with the Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai, India. Her research interests include applications of nonlinear optics, optical signal processing for communication systems and fiber lasers. She has authored more than 100 publications in international peer-reviewed journals and conferences. She is a Senior Member of the Optical Society and has been a frequent reviewer of several IEEE and OSA journals. She is currently an Associate Editor for the OSA journal, Advances in Optics and Photonics.

COURSE PLAN :

Week 1 : Motivation for fiber optic communication, Introduction to digital modulation, Overview of Optical Communication System

Week 2 : Optical Sources : LED - Working principle, Efficiency, Modulation bandwidth, Emission Pattern, Need for Laser Diodes, Resonator Concepts

Week 3 : Optical Sources : Laser Diodes - Resonator, FSR, Q, Single Longitudinal Mode Lasers, Photon Lifetime, Semiconductor,Laser Rate equation, steady state solution, LI characteristics, Output power from laser, Modulation response of LD,Chirp

Week 4 : Optical Sources- Noise in Lasers- Relative Intensity Noise, Phase noise, Effect of noise on different modulation schemes, External Modulation- generation of OOK, BPSK, QPSK and 16QAM

Week 5 : Optical Fibers - Attenuation in fibers, Modes of a step index fiber, b-V curves, Modal profiles

Week 6 : Optical Fibers- Dispersion in fibers, intermodal dispersion, material dispersion, waveguide dispersion, polarisation mode dispersion

Week 7 : Photo detectors- PIN and APD Detectors, Sources of Noise- shot noise, thermal noise, NEP, SNR, Heterodyne detectors, SNR in heterodyne detection

Week 8 : Optical Link Design - Performance Evaluation of an OOK link- BER, Q, Receiver Sensitivity, Optical Amplifiers- EDFA

Week 9 : Optical Link Design Link Budget, Case Studies, Dispersion COmpensation, Nonlinear Effects- Self Phase Modulation

Week 10 : Nonlinear effects - Cross Phase Modulation, Four Wave Mixing, Stimulated Raman and Brillouin Scattering, Commonly used components in Optical Networks

Week 11 : Coherent Detection and DSP : Balanced Detection, Phase and Polarisation Diverse Coherent Detection, Digital Signal Processing for compensation of phase noise, frequency offset, chromatic dispersion, polarisation mode dispersion

Week 12 : Optical Networks : SDH/SONET Layering, Frame Structure , Physical network topologies, Access Networks- PON ,Optical Interconnects, Data Centers ,Optical communication for Wireless Fronthauling.