OPTICAL FIBER COMMUNICATIONS

(Professional Elective –II)

Course Code: 15EC1119

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Pre-requisites:

Basics of Digital and Analog communications.

Course Outcomes:

At the end of the Course, the Student will be able to:

CO 1 Comprehend fiber Optic Communications and fiber materials.

CO 2 Assess the transmission Characteristics of signals through fibers.

CO 3 Compare and analyze the characteristics of various optical sources and detectors.

CO 4 Design optical links for Analog and Digital optical communication systems and estimate power budget.

CO 5 Measure attenuation and Dispersion of SONET/SDH, WDM and DWDM.

UNIT-I **(10 Lectures)**

OVERVIEW OF FIBER OPTIC COMMUNICATIONS AND FIBER MATERIALS:

The General System, Advantages of Fiber Optic communications, Total Internal Reflection, Acceptance Angle, Numerical Aperture, Skew rays. Modes, V number, Step index, Graded index Fibers. Cutoff Wavelength, Mode Field Diameter. Fiber materials: Glass, Halide, Chalcogenide fibers, Plastic Optical fibers, Active Glass fibers, Cable Design.

UNIT-II (10 Lectures)

TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS AND OPTICAL FIBER COMPONENTS:

Attenuation, Material Absorption Losses, Linear Scattering losses- Rayleigh, Mie, Non Linear Scattering losses- SBS, SRS, Solitons, Group delay, Dispersion- Intermodal dispersion, Material dispersion, Waveguide dispersion, Polarization mode dispersion. Fiber Splices – Fusion Splices, Mechanical Splices. Passive Components: Couplers, Isolators, Circulators, Bragg Grating, Fabry_Perot filters, Mach-Zehnder Interferometers.

UNIT-III (12 Lectures)

OPTICAL SOURCES AND DETECTORS:

LED structures- Surface Emitter LED, Edge Emitter LED, Quantum Efficiency, LED characteristics- output power, Modulation. Lasers – The Einstein relations, Population Inversion, Threshold condition for Laser oscillation, Laser diode modes, External Quantum Efficiency, Resonant frequencies, Single mode Lasers, modulation of Lasers, Temperature Effects, Reliability considerations of LED and LD Physical principles of Photodiodes, Detector response time, Structure of InGaAs APD, Temperature effect on Avalanche Gain, Comparison of Photodetectors

UNIT-IV (10 Lectures)

OPTICAL RECEIVER OPERATION AND SYSTEM DESIGN:

Fundamental receiver operation – Digital signal transmission, Error sources. Pre Amplifiers : Low impedance front end, High impedance front end, Trans-impedance front end amplifiers, Quantum limit, Eye diagrams. Line coding: RZ, NRZ, Block codes. Point to Point Links –System considerations, Link Power Budget, Rise Time Budget.

UNIT-V (8 Lectures)

MEASUREMENTS AND SDH/SONET:

Measurements of Attenuation and Dispersion, Basics of WDM, DWDM, PDH, SDH.

TEXT BOOKS:

1. John M Senior, "Optical Fiber Communications", PHI, 2nd Edition, 2002.
2. Gerd Keiser, "Optical Fiber Communications", Mc Graw-Hill International edition, 4th Edition, 2000.

REFERENCES:

1. Joseph C.Palias, "Fiber Optical Communications" 5th Edition, Pearson Education, 2004
2. Rajiv RamaSwami, Kumar N Sivarajan, Galen H Sasaki. "Optical Networks A Practical Perspective", 3rd Edition.