16EC401 OPTICAL COMMUNICATIONS

Hours Per Week :

L	T	P	C
3	-	-	3

Course Description and Objectives:

This course offers fundamental knowledge on optical components such as optical fibers, sources, detectors etc. The objective of this course is to enable the student to understand the basics of optical laws, optical fibre structures, wave guides and signal degradation mechanisium in optical communication system.

Course Outcomes:

Upon successful completion of this course, students should be able to:

CO1: Understand the significance of optical communication and fundamental operating principles.

CO2: Estimate the signal distortion phenomena through various parameters like losses and pulse broadening.

CO3: Understand the principles and Analyze efficiencies of various optical sources.

CO4: Investigate the characteristics of different optical connectors.

CO5: Differentiate various optical detectors.

CO6: Understand and estimate link power budget and rise time budget.

SKILLS:

- ✓ *Choose the type and size of fibre and mode of operation for the given application.*
- ✓ *Estimate the loss and the delay in the fibre link.*
- ✓ *Choose the technique for fibre joint.*
- ✓ *Identify the type of source and detector suitable for specific application and estimate its performance.*
- ✓ *Estimate and evaluate the link budget.*

ACTIVITIES:

- *Choose the fiber to transmit 1 Gbps - 10 Gbps data over 500 meters distance.*
- *Find NA and attenuation of a given fibre.*
- *Verify the power output vs I/p Voltage of a given LED/ LASER.*
- *Verify the output current vs I/p power of a given detector.*
- *Choose the receiver front end for the 1 Gbps data link receiver.*

UNIT - 1 **L-9**

OVERVIEW OF OPTICAL FIBER COMMUNICATION: The general system, Advantages of optical fiber communications, Fiber materials, Optical fiber wave guides - Introduction, Ray theory transmission, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays; Cylindrical fibers - Modes, V-number, Mode coupling, Step index fibers, Graded index fibers.

UNIT - 2 **L-9**

SIGNAL DEGRADATION IN OPTICAL FIBERS: Signal distortion in optical fibers- Attenuation, Absorption, Scattering and bending losses, Core and cladding losses, Information capacity determination, Group delay; Types of dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion; Overall fiber dispersion in multi-mode and Single mode fibers, Pulse broadening.

UNIT - 3 **L-9**

OPTICAL FIBER CONNECTORS: Connector types, Single mode fiber connectors, Connector return loss, Fiber splicing - Splicing techniques, Splicing single mode fibers; Fiber alignment and joint loss - Multimode fiber joints, Single mode fiber joints.

UNIT - 4 **L-9**

OPTICAL SOURCES: LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product, Injection laser diodes- modes, Threshold conditions, External quantum efficiency, Laser diode rate equations.

UNIT - 5 **L-9**

OPTICAL DETECTORS: Physical principles of PIN and APD, Comparison of photo detectors, Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Quantum limit, Analog receivers, Optical system design-Considerations, Component choice, Multiplexing, Point to- point links, System considerations, Link power budget, Rise time budget.

TEXT BOOKS:

1. Gerd Keiser, “Optical Fiber Communications”, 4th edition, McGraw-Hill International, 2015.
2. John M. Senior, “Optical Fiber Communications”, 3rd edition, PHI, 2013.

REFERENCE BOOKS:

1. S.C.Gupta, “Text Book on Optical Fibre Communication and its Applications”, 3rd edition, PHI, 2005.
2. Govind P. Agarwal, “Fiber Optic Communication Systems”, 3rd edition, John Wiley, 2004.
3. Joseph C. Palais, “Fiber Optic Communications”, 4th edition, Pearson Education, 2004.