

OPTICAL FIBER COMMUNICATION SYSTEM**EX 765 01****Lecture : 3****Year : IV****Tutorial : 1****Part : II****Practical : 3/2****Course Objective:**

To introduce the concept of optical fiber communication

1. Introduction to Optical Fiber Communication (2 hours)

- 1.1 Evolution of optical fiber communication
- 1.2 Optical fiber communication system
- 1.3 Advantage of optical fiber communication
- 1.4 Applications of optical fiber communication

2. Light Transmission in Optical Fiber (2 hours)

- 2.1 Introduction of optical fiber structure
- 2.2 Total internal reflection
- 2.3 Acceptance angle
- 2.4 Numerical aperture
- 2.5 Meridional and skew rays in optical wave guide

3. Electromagnetic Theory for Optical Propagation (2 hours)

- 3.1 Review of Maxwell's equation
- 3.2 The wave equation for slab waveguide
- 3.3 Wave equation for cylindrical waveguide

4. Mode Propagation in Optical Waveguide (3 hours)

- 4.1 Modes in a planar optical guide
- 4.2 Phase and group velocity
- 4.3 Evanescent field
- 4.4 Modes in cylindrical optical waveguide
- 4.5 Mode coupling

5. Optical Fibers (5 hours)

- 5.1 Introduction and types
- 5.2 Modes in multimode fibers: step index and graded index
- 5.3 Modes in step index and graded index single mode fiber
- 5.4 Cutoff wavelength, mode-field diameter and spot size
- 5.5 Transmission properties of optical fiber
- 5.6 Fiber attenuation
- 5.7 Fiber bend loss
- 5.8 Fiber dispersion

- 6. Optical Source for Optical Fiber Communication (4 hours)**
- 6.1 Introduction, types and requirements
 - 6.2 Light emitting diode (LED)
 - 6.3 Laser diode (LD)
 - 6.4 Properties of optical sources
- 7. Optical Detectors (4 hours)**
- 7.1 Introduction
 - 7.2 Semiconductor photodiode
 - 7.3 PIN photodiode
 - 7.4 Avalanche photodiode
 - 7.5 Comparison of different photodiodes
 - 7.6 Properties of photodiodes
- 8. Optical Modulation (3 hours)**
- 8.1 Introduction and types
 - 8.2 Analog modulation
 - 8.3 Digital modulation
- 9. Connectors and Couplers (6 hours)**
- 9.1 Introduction to optical connections
 - 9.2 Optical fiber connectors: Principle and types
 - 9.3 Characteristic losses in connectors
 - 9.4 Optical fiber splices: Principle and types
 - 9.5 Comparison of different types of splices
 - 9.6 Comparison between splice and connector
 - 9.7 Introduction to optical couplers and their types
 - 9.8 Fused biconical taper (bus) coupler
 - 9.9 Fused star coupler
 - 9.10 Characteristic properties of optical couplers
 - 9.11 Fully bidirectional four port optical coupler
 - 9.12 Asymmetrical bidirectional three port optical coupler (ABC)
 - 9.13 Comparison between four port full bidirectional coupler made with traditional three port coupler and ABC
- 10. Fiber Amplifiers and Integrated Optics (4 hours)**
- 10.1 Introduction
 - 10.2 Rare earth doped fiber amplifier
 - 10.3 Raman and Brillouin fiber amplifier
 - 10.4 Integrated optics
 - 10.5 Optical switch
- 11. Optical Fiber Network (10 hours)**
- 11.1 Introduction to analog and digital fiber optic transmission
 - 11.2 Optical fiber local area networks
 - 11.3 Design of passive digital fiber optic networks

Practicals:

1. Familiarization with optical fiber laboratory, safety and precaution.
Demonstration of the concept of light propagation in optical waveguide with the help of polymer rod and water spout
2. Determination of fiber numerical aperture and fiber attenuation
3. Plotting a power-current characteristic for LED
4. Determination of different optical fiber connector losses.
5. Determination of coupling efficiency/loss from source to fiber, fiber to fiber, and fiber to photodetector.
6. Digital optical transmission.

References:

1. John M. Senior, "Optical Fiber Communications – Principles and Practice", Prentice Hall.
2. William B. Jones. Jr. "Introduction to Optical Fiber Communication Systems", Holt, Rinheart and Winston, Inc.
3. Gerd Keiser, "Optical Fiber Communication", Second edition, McGraw Hill, Inc.
4. Roshan Raj Karmacharya, "Passive Optical Fiber LAN Design". M.Sc. Thesis, University of Calgary, Canada.