Subject Code: 01CT1508

Subject Name: Optical Communication

B. Tech. Year – III (Semester V)

Objective: To introduce the students to various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and to study about various optical sources and optical detectors and their use in the optical communication system, optical amplifiers, fiber network elements, basic optical components, and techniques of fiber optic measurement

Credits Earned: 04 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Learn basic elements of optical fiber transmission link, fiber modes and physics of fiber structure configurations and fiber losses (Understand).
2. Compare the various type of the optical source and optical detectors (Analyze).
3. Analyze the optical system performance with optical transmitter, receiver, amplifier,splitter and other optical devices (Analyze).
4. To analyze and design optical fiber link with encapsulation of different system components and optical parameter measurement devices (Analyze).
5. To analyze and integrate fiber optical network components in variety of networking schemes, SONET/ SDH and operational principles WDM (Analyze).

Pre-requisite of course: Fundamentals of signals, Modulation techniques and Fundamental concept oflights from physics

Teaching and Examination Scheme:

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial / Practical Marks		Total Marks
				E	I		V	T	
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term Work	
03	00	02	04	50	30	20	25	25	150

Content:

Unit	Topics	Content Hours
1	**Overview of Optical fiber Communications** Electromagnetic spectrum, Optical Spectral bands, Evolution of fibre optic system, Multiplexing Techniques, Elements of an optical fibre transmission link with the functional description of each block, WDM concepts, transmission widows, advantages of optical fibre link over conventional copper systems, applications of fibre optic transmission systems.	8
2	**Optical Fibers** Optical laws and definitions, optical fiber modes and configurations, Mode theory, Step Index and Graded Index (GI) fibers, single mode and graded index fibers, Derivation for numerical aperture, V number and modes supported by step index fiber, mode field, Numerical aperture and modes supported by GI fibers, fiber materials, linearly Polarized modes fiber fabrication techniques, and mechanical properties of fibers, fiber optic cables.	10
3	**Signal Degradation in Optical Fibers** Attenuation, signal distortion in optical waveguides, pulse broadening in graded index fiber, Characteristics of Single Mode Fibers, mode coupling, InternationalStandards for optical transmission fibers.	04
4	**Optical Sources and Detectors** Semiconductor Physics background, Light emitting diode (LED) structures,materials, Figure of merits, characteristics & Modulation. Laser Diodes -Modes & threshold conditions, Diode Rate equations, resonant frequencies, structures, characteristics and figure of merits, single mode lasers, Modulation of laser diodes, Spectral width, temperature effects, and Light source linearity, Principles of operation of photodetectors, detector types, characteristics, figure of merits of detectors photodiode materials, photodetector noise, detector response time, temperature effects on gain, comparison of photodetectors.	07
5	**Advance optical fiber system** Point to point link communication system, Link power budget calculation, Semiconductor optical amplifier, EDFA, Raman amplifier, WDM, DWDM, SONT/SDH, Field deployment, Undersea deployment, Typical end to enddeployment including last mile, Introduction to SFP, Examples of products.	07
6	**Optical Component and Fiber Optical measurement** Optical couplers, Filters, Add and drop MUX/DEMUX, waveguide grating Circulator, Interferometer, Wavelength convertor, OTDR, Test Equipment Attenuation and dispersion measurement, NA and EYE pattern measurement	06
	Total Hours	**42**

Suggested Text books / Reference books:

1. Optical Fiber Communications by Gerd Keiser, 4th Edition (Mc Graw Hill)
2. Optical Fiber Communication by John M. Senior (PHI/Pearson)
3. Fiber optic Communication Systems by G. Agrawal (John Wiley and sons)
4. Optical fiber communications: Principles and Applications by T. L. Singal (Cambridge University Press).
5. Optical Networks by Rajiv Ramaswami (Morgan Kaufmann Press)
6. Fiber-Optic Communication: Systems and Components by Sunita P Ugale Vivekanand Mishra(Wiley)

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution servesas guidelines for teachers and students to achieve effective teaching- learning process.

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
20%	20%	30%	15%	10%	5%

Suggested List of Experiments:

1. Setting -up of Analog/ Digital Optical communication Link
2. Measurement of attenuation characteristics of an optical fiber
3. Measurement of NA of a multimode fiber
4. Measurement of Dispersion of optical fiber
5. Performance of TDM on fiber optic link
6. Setting -up of voice link on Optical communication Link.
7. Performing Experiments on the VI characteristics of the optical Sources.
8. Performing Experiments on the characteristics of the optical detectors.
9. Design directional coupler using FEM simulation technique.
10. Design split ring resonator using FEM techniques.
11. Design the 90-degree optical waveguide using photonics crystal.
12. Design the 2-dimensional optical waveguide using FEM technique.
13. To perform micro-bending loss of given single or multimode optical fiber. (Hint: usingcorrugated structure and weights)
14. To perform macro-bending loss of given multimode optical fiber. (Hint: making the number ofloops around the cylindrical mendral.)
15. Find out of Mode Field Diameter (MFD) of given single mode fiber. (Hint: Using a pin holedetector, graph papers and formula, we can calculate MFD.)

Supplementary Resources:

1. https://www.nptel.ac.in/courses/117101054/
2. https://nptel.ac.in/courses/117101002/