COURSE TITLE	**OPTICAL COMMUNICATION**
COURSE CODE	**01CT1508**
COURSE CREDITS	**4**

Objective:

1 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

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 of lights from physics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact 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 fiber link over conventional copper systems, applications of fiber optic transmission systems	8

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Contents : Unit	Topics	Contact Hours
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, modes supported by GI fibers, fiber materials, linearly Polarized modes fiber fabrication techniques,, 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	4
4	**Optical Sources and Detectors** Semiconductor Physics background,, Light emitting diode (LEDs)-structures, Light emitting diode (LEDs)-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	7
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 deploymen, Typical end to end deployment including last mile,, Introduction to SFP, Examples of products.	7
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	6
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Experiments-1** Setting -up of Analog/ Digital Optical communication Link	2
2	**Experiments-2** Measurement of attenuation characteristics of an optical fiber	2
3	**Experiments-3** Measurement of NA of a multimode fiber	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
4	**Experiments-4** Measurement of Dispersion of optical fiber	2
5	**Experiments-5** Performance of TDM on fiber optic link	2
6	**Experiments-6** Setting -up of voice link on Optical communication Link.	2
7	**Experiments-7** Performing Experiments on the VI characteristics of the optical Sources.	2
8	**Experiments-8** Performing Experiments on the characteristics of the optical detectors.	2
9	**Experiments-9** Design directional coupler using FEM simulation technique.	2
10	**Experiments-10** Design split ring resonator using FEM techniques.	2
11	**Experiments-11** Design the 90-degree optical waveguide using photonics crystal.	2
12	**Experiments-12** Design the 2-dimensional optical waveguide using FEM technique.	2
13	**Experiments-13** To perform micro-bending loss of given single or multimode optical fiber. (Hint: using corrugated structure and weights)	2
14	**Experiments-14** To perform macro-bending loss of given multimode optical fiber. (Hint: making the number of loops around the cylindrical mendral.)	2
15	**Experiments-15** Find out of Mode Field Diameter (MFD) of given single mode fiber. (Hint: Using a pin hole detector, graph papers and formula, we can calculate MFD.)	2
Total Hours		**30**

Textbook :

1 Optical Fiber Communications, Gerd Keiser, McGraw Hill Education, 2017

2 Optical Fiber Communication , John M. Senior, PHI/Pearson, 2019

References:

1 Fiber optic Communication Systems, Fiber optic Communication Systems, G. Agrawal, John Wiley and sons, 2012

2 Optical fiber communications: Principles and Applications, Optical fiber communications: Principles and Applications, T. L. Singal , Cambridge University Press, 2017

3 Optical Networks, Optical Networks, Rajiv Ramaswami , Morgan Kaufmann Press, 2009

References:

4 Fiber-Optic Communication: Systems and Components, Fiber-Optic Communication: Systems and Components, Sunita P Ugale Vivekanand Mishra, Wiley, 2013

Suggested Theory Distribution:

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

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
20.00	20.00	30.00	15.00	10.00	5.00

Instructional Method:

1 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

2 Practical examination will be conducted at the end of the semester for evaluation of performance of students in laboratory.

3 Students may use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory, etc.

4 The course delivery method will depend upon the requirement of content and need of the students. The teacher in addition to conventional teaching method (Chalk and Talk) may use any of the tools such as demonstration, role play, Quiz, brainstorming, Flipped class, Project based learning, Collaborative learning, MOOCs etc. for effective teaching.

Supplementary Resources:

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

2 https://nptel.ac.in/courses/117101002/

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