GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3163208
OPTICAL COMMUNICATION
B.E. 6th SEMESTER

Type of course: Undergraduate (Elective)

Prerequisite: Semiconductor Physics, Electromagnetics

Rationale: 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.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	**Overview of Optical fiber Communications:** Basic network information rates, Evolution of fiber optic systems, Elements of an optical fiber transmission link, Advantages and disadvantages of optical fiber system.	3	6
2	**Introduction to optical fibers:** Fundamentals of Light Propagation in Optical Fiber, Numerical aperture, Multimode Fibers, Single Mode Fibers, Step Index and Graded Index (GI) fibers, Attenuation and Dispersion.	7	20
3	**Optical Sources:** Light emitting diode (LEDs) - Structures, Materials, Characteristics & Modulation, Laser Diodes -Modes & threshold condition, Structures, Single mode lasers.	6	12
4	**Photo detectors:** Principles of operation, types, characteristics, figure of merits of detectors photodiode materials, photo detector noise.	4	10
5	**Optical Receiver Operation:** Receiver operation, Preamplifier types, receiver performance and sensitivity, Eye diagrams, Coherent detection, Specification of receivers.	5	10
6	**Transmission Systems:** Point –to-point link –system considerations, Link power budget and rise time budget methods for design of optical link, BER calculation.	3	10
7	**Optical Amplifiers:** Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers.	3	8
	Overview of Optical Components:		

8	Optical couplers, Tunable sources and Filters, optical MUX/DEMUX, Arrayed waveguide grating, optical add drop multiplexer (OADM), optical circulators, attenuators, optical cross connects, wavelength converter, Mach-Zender Interferometer.	**3**	**10**
9	**Advances in Optical Fiber Systems:** Principles of WDM, DWDM, Telecommunications & broadband application, SONET/SDH, MUX, Analog & Digital broadband, optical switching.	**5**	**8**
10	**Fiber Optical Measurements**: Test equipment, OTDR, Set ups for Measurement of Attenuation, Dispersion, NA and EYE pattern.	**3**	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	**15**	**10**	**15**	**10**	**10**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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 optical communication Technology by Djafar Mymbaev & Lowell L, Scheiner. (Pearson).
4. Fiber optic Communication Systems by G. Agrawal (John Wiley and sons).

Course Outcome: After learning the course the students will be able

Sr. No.	**CO Statement**	**Marks % Weightage**
CO-1	Understand and classify the structures of optical fibers.	25
CO-2	Analyze the different optical sources and detectors.	20
CO-3	Performance evaluation of optical receiver.	10
CO-4	Design and analyze optical transmission systems.	15
CO-5	Identify the various components for optical communication.	25
CO-6	Use the various optical measurement techniques.	5

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 Mode field diameter of a single mode fiber.
5. Measurement of Dispersion of optical fiber.
6. Performance of PAM on fiber optic link.
7. Performance of PWM on fiber optic link.
8. Performance of PPM on fiber optic link.
9. Measurement of attenuation with OTDR.
10. Measurement of emission wavelength of LED/LASER source.
11. Measurement of Data quality with EYE PATTERN.
12. Preparation of optical fiber end and practices on splicing/connectorization.
13. Performance of TDM on fiber optic link.
14. Setting -up of voice link on Optical communication Link.
15. Performing Experiments on the VI characteristics of the optical Sources.
16. Performing Experiments on the characteristics of the optical detectors.

Design based Problems (DP)/Open Ended Problem:

Open ended Problem:

1. Calculation of G. I. fiber parameters like Normalized frequency, No. of Guided Modes based on given data.
2. Determining the S.I. fiber parameters based on given data.
3. Calculation and determination of fiber optical sources parameters like LED, LASER based on given data.
4. Analysis of power link budget and various parameters.
5. Determination and calculations of various photo detectors (PIN, APD) parameters based on given data.
6. Analysis and calculations of various parameters of fiber optic passive network components.

Major Equipments: Fiber Optical Trainer Kit, Laser Source, Photo Detector, Optical Power Meter, OTDR,WDM trainer setup, splicing and connectorization kits.

List of Open Source Software/learning website:

1. http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Optical%20Communication/Course%20Objective.htm