SARVAJANIK UNIVERSITY
Sarvajanik College of Engineering and Technology
Bachelor of Technology

B. Tech. Semester VI

Subject Name: **Fiber Optic Communication** **Subject Code: BTEC13602**

Type of course: PCC

Prerequisite: Semiconductor Physics, Electromagnetic, Mode theory of waveguide, Analog Communication.

Rationale: students will learn various optical fiber modes, configurations and various signal degradation factors associated with optical fiber and will study about various optical sources and optical detectors with their use in the optical communication system, optical amplifiers, fiber network elements, basic optical components, and techniques of fiber optic communication system. In addition, students will explore the performance of the point to point link.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
3	0	2	4	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Content:

Sr. no.	Topics	Teaching Hrs.	Module % Weightage
1.	**Overview of Optical fiber Communications :** Electromagnetic spectrum, Optical Spectral bands, Evolution of fiber optic system, Multiplexing Techniques, Elements of an optical fiber transmission link with the Functional description of each block, transmission windows, advantages of optical fiber link over conventional copper systems, applications of fiber optic transmission systems, Optical laws and definitions, fabrication techniques, and mechanical properties of fibers, fiber optic cables.	3	10
2.	**Optical fibers : Structures, Wave theory- Modes in Optical Fiber, Losses** 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, Attenuation, signal distortion in optical waveguides,	8	15

	pulse broadening in graded index fiber, Characteristics of Single Mode Fibers, mode coupling, international Standards for optical transmission fibers.		
3.	**Optical Sources :** Semiconductor Physics background, 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.	6	15
4.	**Photo detectors and Receiver Operations:** Principles of operation, types, characteristics, figure of merits of detectors .Photodetector noise, response time, temperature effects and gain, comparison of photo detectors. Preamplifier types, receiver operation, performance and sensitivity. Eye diagrams, Coherent detection. Specification of receivers.	8	15
5.	**Optical Components & Amplifier :** Optical couplers, Tunable sources and Filters, optical MUX/DEMUX, Arrayed waveguide, grating, optical add drop multiplexer (OADM), optical Circulators, attenuators, cross connects, wavelength converter, Mach-Zender interferometer. Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers.	9	20
6.	**Transmission System, Power Launching and Coupling :** Point–to-point link system considerations, power launching, Lensing schemes, fiber-to-fiber joints. Fiber splicing, Optical fiber connectors. Link power budget and rise time budget methods for design of optical link, BER calculation. Test Equipment-OTDR.	6	15
7.	**Advances in Optical Fiber Systems :** Principles of WDM, DWDM, Telecommunications & broadband application, introduction to SONET/SDH, Analog & Digital broadband, optical switching, Introduction to PON.	5	10

Suggested Specification table with Marks (Theory):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	20	40	15	5	-

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **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 Text Books:

Sr. No.	Title of book /article	Author(s)	Publisher and details like	Year of publication	Publication Edition
1.	Optical Fiber Communications	Gerd Keiser	Mc Graw Hill	2017	5th
2.	Optical Fiber Communication	John M. Senior	PHI/Pearson	2010	3rd
3.	Fiber optical communication Technology	Djafar Mymbaev	Pearson	2000	Latest
4.	Fiber optic Communication Systems	G. Agrawal	Academic Press	2002	Latest

Course Outcome:

Sr. No.	CO Statement After learning this subject students will be able to	Marks % weightage
CO-1	Apply the principles and operation of fiber optic communication system.	10
CO-2	Explain and Classify different kind of losses, signal distortion of transmission link and use of various optical components constituting optical fiber links for establishment of end to end fiber optic communication link.	40
CO-3	Analyze various optical source, detectors, components, amplifier requirement for application specific bandwidth, efficiency and sensitivity.	30
CO-4	Analyze the measurement of link performance, tools and instruments for identification of faults.	20

Mapping with POs:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	2	2	2	2	2	-	2	2	2	-	2	2	-	-
CO-2	2	2	1	2	2	2	2	2	2	2	-	2	2	-	-
CO-3	3	3	1	3	2	3	-	3	2	2	2	2	2	-	2
CO-4	3	3	2	3	2	3	1	3	2	2	2	2	2	-	2

List of Practical:

1 To measure and analyze the attenuation of Fiber Optic Analog Communication link by using different Transmitter and Receiver Module of Experiment kit Set-up.

2. To measure and analyze the distortion of Fiber Optic Digital Communication link by using different Transmitter and Receiver Module of Experiment Set-up.

3 To measure and compare the Attenuation Characteristic and Propagation Loss with the help of 1m, 3m and 5m Multimode Plastic fiber on Experiment Set-up Modules.

4 (a) To measure the Numerical Aperture for Multimode Plastic fiber with optical communication link set-up.
(b) Write a computational program for analytical analysis of Numerical Aperture for given optical communication link set-up parameters.

5 To observe and analyze the performance of the Pulse Width Modulation Signal behavior for different pulse rate by using optical link of different Transmitter and Receiver Experiment Set-up Modules.

6 To observe and analyze the performance of the Pulse Position Modulation Signal behavior for different pulse rate by using optical link of different Transmitter and Receiver Experiment Set-up Modules.

7 To Measure Data Quality of Fiber Optic link with the help of 'EYE Pattern' by using Laboratory kit Experiment Set-up.

8. To Measure the Bit Error rate of Fiber Optic link with Laboratory kit Experiment Set-up.

10. To prepare the Optical Fiber end and practices on 'Splicing/Connectorization'.

11. To measure the Voltage and Current of Experiment kit setup detector and plot the characteristics Detectors and compare the result of different detectors,

12. To Measure the emission wavelength and radiation power of LED/LASER source.
Mini-;project

List of Open Source/learning website:

- Fiber Optic Communication Technology
  Web Link: https://nptel.ac.in/courses/108/106/108106167/
- Optics Communication system and Techniques
  Web Link: https://nptel.ac.in/courses/108/104/108104113/
- Optical Communication (Web)
  Web Link: https://nptel.ac.in/courses/117/101/117101054/
- Optical Communications
  Web Link: https://nptel.ac.in/courses/117/104/117104127/
- Fiber optics Fundamentals (MIT, USA)
  Web Link: https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/index.htm