INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

OPTICAL COMUNICATIONS								
V Semester: ECE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
AECD24	**Elective**	3	-	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Applied Physics								

I. COURSE OVERVIEW:
The objective of the course is to understand optical communication systems, light wave propagation along step and graded index fibers. It covers optical fibers, lasers, detectors, optical amplifiers, Coherent and incoherent optical sources and modulation techniques, PIN and APD based optical receivers and various noise processes. The course will conclude with outlook for future research in extending the capabilities of these networks to higher bandwidths and quantum-secured communications.

II. COURSES OBJECTIVES:
The students will try to learn

I. The students understand the various process and subsystems involved in the optical communication.
II. The different multiplexing technologies in the fiber optic communication.
III. To design optical communication systems to serve a defined purpose.

III. COURSE OUTCOMES:
At the end of the course students should be able to:

CO 1	Understand the fundamental principles of light propagation in optical fibers and distinguish between different types of fibers based on modal characteristics.
CO 2	Analyze various signal degradation mechanisms such as attenuation and dispersion, and explain the working principles and characteristics of optical sources like LEDs and laser diodes.
CO 3	Demonstrate knowledge of optical detectors including PIN and avalanche photodiodes, and evaluate their performance based on sensitivity, responsivity, and quantum efficiency.
CO 4	Explain and compare multichannel transmission techniques such as frequency modulation, subcarrier multiplexing, and WDM along with their components.
CO 5	Understand the operating principles of different optical amplifiers including EDFA, Raman, and semiconductor amplifiers, and assess their performance metrics such as gain and noise figure.
CO 6	Evaluate various optical network architectures and advanced concepts like soliton-based communication systems and dispersion compensation techniques in high-capacity WDM systems.

IV. COURSE CONTENT:

MODULE - I: OVERVIEW OF OPTICAL FIBRE COMMUNICATION (10)
Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod; rays and modes; different types of optical fibers, modal analysis of a step index fiber, linearly polarized modes, single mode fibers and graded - index fiber.

MODULE –II: SIGNAL DEGRADATION AND OPTICAL SOURCES (08)
Attenuation- Absorption, scattering losses, bending losses, core and cladding losses; signal distortion in optical waveguides; Material Dispersion, Waveguide Dispersion; Optical sources; Semiconductor device fabrication, LED and LASER diode; Principles of operation, concepts of line width, phase noise, switching and modulation characteristics.

MODULE –III: OPTICAL DETECTORS (10)
Optical detectors: pin detector, avalanche photodiode - Principles of operation, concepts of responsively, sensitivity and quantum efficiency, noise in detection.

Multichannel Transmission Technique-Multichannel Frequency Modulation, Subcarrier multiplexing. WDM Concepts and Components.

MODULE –IV: OPTICAL AMPLIFIERS (09)
Basic concepts, semiconductor amplifier, erbium-doped fiber amplifier, Raman amplifier, Brillouin amplifier - principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, inter modulation effects, saturation induced crosstalk, wavelength range of operation.

MODULE –V: OPTICAL NETWORKS AND DISPERSION COMPENSATION (09)
Optical networks: SONET/SDH, ATM, IP, wavelength routed networks, soliton communication system, fiber soliton, soliton-based communication system design, high capacity and WDM soliton.

V. TEXT BOOKS:

1. Keiser. G, “Optical fiber communications”, Tata McGraw-Hill, 4th Edition, New Delhi,2008.
2. Agrawal. G.P, “Fiber-Optic Communication Systems” John Wiley & Sons, 3rd Edition, 2002.
3. Emmanuel C, Ifeacher, Barrie. W. Jervis, DSP-A Practical Approach, Pearson Education, 2nd Edition, 2002.

VI. REFERENCE BOOKS:

1. John Gowar, “Optical Communication Systems”, Prentice Hall, 2nd Edition, 1993.
2. Franz, Jain, “Optical communication, Systems and Components”, Narosa Publications, 1st Edition New Delhi, 2000.
3. Karminvov, T. Li “Optical Fibre Telecommunications”, Vol A & B, Academic Press, 2002.

VII. ELECTRONICS RESOURCES:

1. NPTEL: Fiber Optic Communication Technology,
2. NPTEL: Digital Communication for Optical Communication
3. NPTEL: Optical Sources: Laser Diodes - Resonator
4. NPTEL: SDH/SONET Layering, Frame Structure
5. https://nptel.ac.in/courses/108104113
6. https://onlinecourses.nptel.ac.in/noc21_ee42/preview

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper - II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation