KADI SARVA VISHWAVIDYALAYA

B.E. Semester: VI
Electronics & Communication Engineering
Subject Name: Optical Fiber Communication
Subject Code: EC-604   W.E.F.-2014-2015

A. Course Objective:

The educational objectives of this course are

- To present a problem oriented introductory knowledge of Optical Fiber Communication.

- To address the underlying concepts and methods behind Optical Fiber Communication.

B. Teaching / Examination Scheme:

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
EC-604	**Optical Fiber Communication**	3	0	2	5	4	3	70	30	20	30	150

C. Detailed Syllabus:

1   Overview Of Optical Fiber Communications :
Electromagnetic spectrum, Evolution of fiber optic system, Elements of an optical fiber transmission link, WDM concepts, transmission widows, advantages of optical fiber link over conventional copper systems, applications of fiber optic transmission systems.

2   Optical Fibers : Structures, Wave Guiding And Fabrication
Basic optical laws and definitions, optical fiber modes and configurations, Mode theory, single mode and graded index fibers, Derivation for numerical aperture, V number, M modes
Supported by step index fiber and GI fibers, fiber materials, fabrication and mechanical properties, fiber optic cables.

3   Signal Degradation In Optical Fibers
Attenuation, Types of losses, Effect of Dispersion on Pulse Transmission, Combined Losses in the fiber, Characteristics of Single Mode Fibers, mode coupling.

4   Optical sources: Topics from semiconductor physics, LEDs-structures, materials, Figure of merits, characteristics & Modulation. LASER diodes, diode rate equations, Figure of merits, characteristics & Modulation, spectral width, temperature effects.
Photo detectors: Principles of operation, types, characteristics, figure of merits of detectors photodiode materials.

5   Power Launching & Coupling : Source To Fiber Power Launching, Lensing Schemes, Fiber To Fiber Joints, Connectors, Splicing.

6   Optical receiver operation and transmission systems :
Receiver operation, Eye diagrams, fundamental concept of Coherent detection.
Point –to-point link –system considerations, Link power budget and rise time budget methods for design of optical link, BER calculation.

7 **Advances In Optical Fiber Systems**
   Principles of WDM, DWDM, SONET/SDH, EDFA.
8 **Optical Amplifiers & Optical Componants :** Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers. Optical Couplers, Optical MUX-DEMUX, OADM, optical Circulators, attenuator, Wavelength Converter
9 **Fiber Optical Measurements :** Measurement of Attenuation, Dispersion, NA, OTDR, EYE pattern Technique.

D. Lesson Planning:

SR. No.	No. of Hours.	% Weight-age in Exam	Topics
1	04	05	Electromagnetic spectrum, Evolution of fiber optic system, Elements of an optical fiber transmission link, WDM concepts, transmission widows, advantages of optical fiber link over conventional copper systems, applications of fiber optic transmission systems.
2	07	15	Basic optical laws and definitions, optical fiber modes and configurations, Mode theory, single mode and graded index fibers, Derivation for numerical aperture, V number, M modes Supported by step index fiber and GI fibers, fiber materials, fabrication and mechanical properties, fiber optic cables.
3	05	15	Attenuation, Types of losses, Effect of Dispersion on Pulse Transmission, Combined Losses in the fiber, Characteristics of Single Mode Fibers, mode coupling.
4	07	20	**Optical sources:** Topics from semiconductor physics, LEDs-structures, materials, Figure of merits, characteristics & Modulation. LASER diodes, diode rate equations, Figure of merits, characteristics & Modulation, spectral width, temperature effects. **Photo detectors:** Principles of operation, types, characteristics, figure of merits of detectors photodiode materials.
5	06	10	Source To Fiber Power Launching, Lensing Schemes, Fiber To Fiber Joints, Connectors, Splicing.
6	05	5	Receiver operation, Eye diagrams, fundamental concept of Coherent detection. Point –to-point link –system considerations, Link power budget and rise time budget methods for design of optical link, BER calculation.
7	04	10	Principles of WDM, DWDM, SONET/SDH, EDFA.
8	04	10	Semiconductor optical Amplifier, EDFA, Raman Amplifier, Wideband Optical Amplifiers.Optical Couplers, Optical MUX-DEMUX, OADM, optical Circulators, attenuator, Wavelength Converter

9	03	10	Measurement of Attenuation, Dispersion, NA, OTDR, EYE pattern Technique.
TOTAL	45	100	

E. Instructional Method & Pedagogy (ANNEXURE-I)

F: Suggested list of Experiments:

1   To perform V-I characteristics of the FO-LED and LASER. Plot the graph in Matlab.
2   To perform the transfer characteristics between the detector and source with simplex cable. Plot the graph in MATLAB.
3   To perform the attenuation in the give fiber optic cable.
4   To perform Digital transmission through the fiber optic cable.
5   To perform Analog transmission through the fiber optic cable.
6   To perform the Time Division Multiplexing.
7   To determine Numerical Aperture.
8   To determine far field of LED.
9   To determine the V-number of the photo diode.
10   To perform the voice interface.
11   Plot and compare the emission patterns from a lambertain source and a source with an emission pattern given by $B(\ ) = B_0 \cos^3$. Assume both sources have the same peak radiance B_0, which is normalized to unity in each case.
12   Consider the light source where the emission pattern is given by $B(\ ) = B_0 \cos^m$. Use a computer to plot $B(\ )$ as a function of m in the range of 1 m 20 at viewing angles of 10^0, 20^0 and 45^0. Assume all sources have the same peak radiance B_0.

G: Students Learning Outcomes:

On successful completion of the course

- The student can identify different areas of Optical Fiber Communication. Can find the applications of all the areas in day to day life. Can identify the operations, working, construction, material etc. aspects of LED characteristics, attenuation, NA, voice interface etc.

H: Recommended Study Materials

- **Text & Reference Books:**

1. Optical Fiber Communications By: - Gerd Keiser, 4th Edition (McGraw Hill international edition).

2. Optical fiber communications principles and practice by: - Jhon M Senior (PHI)