EC2402 OPTICAL COMMUNICATION AND NETWORKING L T P C 3 0 0 3

SUBJECT DESCRIPTION AND OBJECTIVES

AIM

- To introduce the various optical fiber modes, configurations and various signal degradation factors associated with optical fiber.
- To study about various optical sources and optical detectors and their use in the Optical communication system. Finally to discuss about digital transmission and its associated parameters on system performance.

OBJECTIVES

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors. Design optimization of SM fibers, RI profile and cut-off wave length.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes and different fiber amplifiers.
- To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
- To learn fiber slicing and connectors, noise effects on system performance, operational principles WDM and solutions.

DESCRIPTION

Fiber-optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fiber. The light forms an electromagnetic carrier wave that is modulated to carry information. First developed in the 1970s, fiber-optic communication systems have revolutionized the telecommunications industry and have played a major role in the advent of the Information Age. Because of its advantages over electrical transmission, optical fibers have largely replaced copper wire communications in core networks in the developed world. Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. The process of communicating using fiber-optics involves the following basic steps: Creating the optical signal involving the use of a transmitter, relaying the signal along the fiber, ensuring that the signal does not become too distorted or weak, receiving the optical signal, and converting it into an electrical signal.

Optical fiber is used by many telecommunications companies to transmit telephone signals, Internet communication, and cable television signals. Due to much lower attenuation and interference, optical fiber has large advantages over existing copper wire in long-distance and high-demand applications. However, infrastructure development within cities was relatively difficult and time-consuming, and fiber-optic systems were complex and expensive to install and operate. Due to these difficulties, fiber-optic communication systems have primarily been installed in long-distance applications, where they can be used to their full transmission capacity, offsetting the increased cost.

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UNIT I INTRODUCTION 9

Introduction, Ray theory transmission- Total internal reflection-Acceptance angle – Numerical aperture – Skew rays – Electromagnetic mode theory of optical propagation – EM waves – modes in Planar guide – phase and group velocity – cylindrical fibers – SM fibers.

UNIT II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS 9

Attenuation – Material absorption losses in silica glass fibers – Linear and Non linear Scattering losses - Fiber Bend losses – Midband and farband infra red transmission – Intra and inter Modal Dispersion – Over all Fiber Dispersion – Polarization- non linear Phenomena. Optical fiber connectors, Fiber alignment and Joint Losses – Fiber Splices – Fiber connectors – Expanded Beam Connectors – Fiber Couplers.

UNIT III SOURCES AND DETECTORS 9

Optical sources: Light Emitting Diodes - LED structures - surface and edge emitters, mono and hetero structures - internal - quantum efficiency, injection laser diode structures - comparison of LED and ILD Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties, Comparison of performance, Photo detector noise -Noise sources , Signal to Noise ratio , Detector response time.

UNIT IV FIBER OPTIC RECEIVER AND MEASUREMENTS 9

Fundamental receiver operation, Pre amplifiers, Error sources – Receiver Configuration – Probability of Error – Quantum limit.

Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements.

UNIT V OPTICAL NETWORKS 9

Basic Networks – SONET / SDH – Broadcast – and –select WDM Networks – Wavelength Routed Networks – Non linear effects on Network performance – Performance of WDM + EDFA system – Solitons – Optical CDMA – Ultra High Capacity Networks.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Optical Fiber Communication – John M. Senior – Pearson Education – Second Edition. 2007

2. Optical Fiber Communication – Gerd Keiser – Mc Graw Hill – Third Edition. 2000

REFERENCES

1. J.Gower, “Optical Communication System”, Prentice Hall of India, 2001

2. Rajiv Ramaswami, “Optical Networks “ , Second Edition, Elsevier , 2004.

3. Govind P. Agrawal, “ Fiber-optic communication systems”, third edition, John Wiley & sons, 2004.

4. R.P. Khare, “Fiber Optics and Optoelectronics”, Oxford University Press, 2007.

MICRO LESSON PLAN

Week	Hours	LECTURE TOPICS	BOOK
UNIT I INTRODUCTION			
I	1.	Introduction (AV Class)	T1
	2.	Ray theory transmission	
	3.	Total internal reflection-Acceptance angle – Numerical aperture (AV Class)	
	4.	Skew rays – Electromagnetic mode theory of optical propagation	
	5.	EM waves – modes in Planar guide	
II	6.	phase and group velocity	
	7.	cylindrical fibers	
	8.	SM fibers(AV Class)	
	9.	Problems	
UNIT II TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS			
II	10.	Attenuation – Material absorption losses in silica glass fibers	T1
III	11.	Linear and Non linear Scattering losses	
	12.	Fiber Bend losses(AV Class)	
	13.	Midband and farband infra red transmission	
	14.	Intra and inter Modal Dispersion , Over all Fiber Dispersion	
	15.	Polarization , non linear Phenomen	
IV	16.	Optical fiber connectors	
	17.	Fiber alignment and Joint Losses	
	18.	Fiber Splices(AV Class)	
	19.	Fiber connectors , Expanded Beam Connectors	
	20.	Fiber Couplers	
UNIT III SOURCES AND DETECTORS			
V	21.	Optical sources: Light Emitting Diodes , LED structures , Surface and edge emitters	T1
	22.	Mono and hetero structures	T2
	23.	Internal - quantum efficiency, injection laser diode structures	
	24.	comparison of LED and ILD	
	25.	Optical Detectors: PIN Photo detectors(AV Class)	
VI	26.	Avalanche photo diodes, construction, characteristics and properties,	
	27.	Comparison of performance	
	28.	Photo detector noise -Noise sources	
	29.	Signal to Noise ratio , Detector response time	
UNIT IV FIBER OPTIC RECEIVER AND MEASUREMENTS			
VII	30.	Fundamental receiver operation	T2
	31.	Pre amplifiers	

VII	32.	Error sources – Receiver Configuration	T2
	33.	Probability of Error – Quantum limit.	
	34.	Fiber Attenuation measurements	T1
VIII	35.	Dispersion measurements	
	36.	Fiber Refractive index profile measurements	
	37.	Fiber cut- off Wave length Measurements	
	38.	Fiber Numerical Aperture Measurements	
	39.	Fiber diameter measurements	
	UNIT V OPTICAL NETWORKS		
IX	40.	Basic Networks (AV Class)	T1
	41.	SONET / SDH(AV Class)	
	42.	Broadcast – and –select WDM Networks	
	43.	Wavelength Routed Networks	
	44.	Non linear effects on Network performance	
X	45.	Performance of WDM + EDFA system	
	46.	Solitons	
	47.	Optical CDMA	
	48.	Ultra High Capacity Networks	

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