Course Code: 16EC430

R16

SIDDHARTH GROUP OF INSTITUTIONS:: PUTTUR
(AUTONOMOUS)
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code: Optical Fiber Communications (16EC430)

Course & Branch: B.Tech - ECE

Regulation: R16

Year & Sem: IV-B.Tech & I-Sem

UNIT –I
INTRODUCTION TO OPTICAL FIBERS

1	Explain the Elements of an optical fiber Transmission link with neat sketch.	[L2][CO1]	**[12M]**
2	a) Explain about the Evolution of optical fiber systems.	[L2][CO1]	**[6M]**
	b) Illustrate on Reflection and Refraction with neat sketch.	[L2][CO1]	**[6M]**
3	a) Elaborate about the total internal reflection with the help of suitable optical cable setup.	[L6][CO1]	**[6M]**
	b) Develop the Expression for Acceptance angle and Numerical aperture.	[L3][CO1]	**[6M]**
4	a) List the applications of optical fiber communication.	[L1][CO1]	**[5M]**
	b) A light wave is travelling in a semiconductor medium (GaAs) of refractive index 3.6.It is incident on a different semiconductor medium (AlGaAs) of refractive index 3.4 & angle of incidence is 80°.Calculate numerical aperture & acceptance angle. Will it result in total internal reflection? Comment on the result.	[L3][CO1]	**[7M]**
5	a) Consider multimode fiber that has a core refractive index of 1.488 and core cladding index difference of 2.0%. Evaluate numerical aperture,critical angle and acceptance angle.	[L3][CO1]	**[6M]**
	b) List out the merits and demerits of optical fiber communication?	[L1][CO1]	**[6M]**
6	a) Define critical angle and also derive the expression for critical angle.	[L1][CO1]	**[6M]**
	b) Discuss the single mode step Index fiber with neat sketch.	[L6][CO1]	**[6M]**
7	a) Explain about the Multimode Step Index fiber with neat sketch.	[L2][CO1]	**[6M]**
	b) Fiber has normalized frequency 26.6 & operating wavelength 1300nm, if the radius of the fiber core is 25µm.Compute the numerical aperture.	[L3][CO1]	**[6M]**
8	a) Compare step index & graded index fiber.	[L2][CO1]	**[6M]**
	b) Explain about multimode Graded Index fiber with neat sketch.	[L2][CO1]	**[6M]**
9	a) Illustrate on Mode theory of Circular Waveguides in detail.	[L2][CO1]	**[5M]**
	b) Calculate number of modes of an optical fiber having diameter of 50µm & n_1 =1.48 & n_2=1.46having operating wavelength 0.82µm.	[L3][CO1]	**[7M]**
10	a) Explain about the Snell's law and significance of numerical aperture.	[L2][CO1]	**[6M]**
	b) Illustrate on ray optics in detail with neat diagrams.	[L2][CO1]	**[6M]**

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UNIT –II
SIGNAL DEGRADATION IN OPTICAL FIBERS

1	Demonstrate any two types of Losses in Optical Fiber Communication System.	[L2][CO2]	**[12M]**
2	a) Explain the Design Optimization of Single mode fibers.	[L2][CO2]	**[8M]**
	b) How to minimize the micro bending losses in the fiber?	[L1][CO2]	**[4M]**
3	a) How attenuation is caused by scattering losses & bending losses?	[L1][CO2]	**[8M]**
	b) Explain in detail about the Mechanisms which causes Absorption.	[L2][CO2]	**[4M]**
4	a) Define linear scattering. Explain about Rayleigh & Mie scattering.	[L1][CO2]	**[6M]**
	b) Develop the expression for waveguide dispersion.	[L3][CO2]	**[6M]**
5	Explain dispersion occurring in multimode fibers in detail with expressions.	[L2][CO2]	**[12M]**
6	a) Distinguish between intrinsic & extrinsic Absorption.	[L4][CO2]	**[6M]**
	b) Determine the theoretical cutoff wavelength for single mode fiber.	[L5][CO2]	**[6M]**
7	a) What is attenuation? Explain in detail.	[L1][CO2]	**[4M]**
	b) Develop the expression for material dispersion.	[L3][CO2]	**[8M]**
8	Analyze pulse broadening in graded index waveguides.	[L4][CO2]	**[12M]**
9	a) Develop the expression for total dispersion in single mode fiber.	[L3][CO2]	**[6M]**
	b) How refractive index profile optimizes the design in a single mode fiber?	[L1][CO2]	**[6M]**
10	a) Illustrate on the two main causes of Intra Modal Dispersion.	[L2][CO2]	**[6M]**
	b) Explain the phenomenon of Rayleigh scattering in scattering loss.	[L2][CO2]	**[6M]**

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UNIT –III
FIBER OPTICAL SOURCES AND COUPLING

1	a) Explain LED Structure with neat sketch.	[L2][CO3]	**[6M]**
	b) A planar LED is fabricated from GaAs which has a refractive index of 3.6. (i) Calculate the optical power emitted into air as a percentage of the internal optical power for the device when the transmission factor at the crystal-air interface is 0.68.(ii) When the optical power generated internally is 50% of the electric power supplied, determine the external power efficiency.	[L4][CO3]	**[6M]**
2	a) Illustrate on light source materials in detail.	[L2][CO3]	**[8M]**
	b) Explain about the surface emitter LED with neat diagram.	[L2][CO3]	**[4M]**
3	a) Explain about the modulation of LED in detail.	[L2][CO3]	**[7M]**
	b) Illustrate on edge emitter LED with neat diagram.	[L3][CO3]	**[5M]**
4	a) Explain about quantum efficiency and LED power.	[L2][CO3]	**[6M]**
	b) Demonstrate on direct and indirect bandgap materials in detail.	[L2][CO3]	**[6M]**
5	a) Explain about resonant frequencies of LASER Diode.	[L2][CO3]	**[7M]**
	b) A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiber that has a refractive index is 1.48. If the fiber and the source are in close physical contact then find the Fresnel reflection at the interface and power loss in dB.	[L3][CO3]	**[5M]**
6	a) Develop the expression for modes and threshold condition of LASER.	[L3][CO3]	**[8M]**
	b) What power is radiated by an LED if its quantum efficiency is 3% and the peak wavelength is 670nm?	[L1][CO3]	**[4M]**
7	a) Illustrate about external quantum efficiency of LASER.	[L2][CO3]	**[6M]**
	b) Develop the rate equation for LASER diode.	[L3][CO3]	**[6M]**
8	a) Explain in detail about Quantum laser.	[L2][CO3]	**[6M]**
	b) Illustrate about source to fiber power launching.	[L2][CO3]	**[6M]**
9	a) Explain in detail the various Lensing schemes for coupling improvement.	[L2][CO3]	**[6M]**
	b) Discuss about Fiber splicing.	[L6][CO3]	**[6M]**
10	a) Explain about mechanical misalignment in fiber to fiber joints.	[L2][CO3]	**[6M]**
	b) Demonstrate on fiber-related losses in fiber to fiber joints.	[L2][CO3]	**[6M]**

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UNIT –IV
FIBER OPTICAL RECEIVERS

1	a) Explain in detail the operation of Avalanche Photo Diode with its structure.	[L2][CO4]	**[7M]**
	b) A photo diode has a quantum efficiency of 65% when photons of energy of 1.5×10^{-19} J are incident upon it. (i) Find the operating wavelength of the photodiode, (ii) Calculate the incident optical power required to obtain a photo current of 2.5nA when the photodiode is operating as described above.	[L3][CO4]	**[5M]**
2	a) Explain about avalanche multiplication noise in APD diode.	[L2][CO4]	**[7M]**
	b) Summarize the comparisons of photo detectors.	[L2][CO4]	**[5M]**
3	a) Explain the principle behind the operation of an PIN photo diode.	[L2][CO4]	**[7M]**
	b) Explain the simple energy band diagram for a PIN photodiode with neat diagram.	[L2][CO4]	**[5M]**
4	a) Illustrate how noises are entered into photo detector.	[L2][CO4]	**[6M]**
	b) Analyze photo detector receiver with simple model and equivalent circuit.	[L4][CO4]	**[6M]**
5	a) Develop the equation for S/N ratio of an optical fiber.	[L4][CO4]	**[6M]**
	b) List the operating parameters of Si, Ge, InGaAs for avalanche photo diode.	[L1][CO4]	**[6M]**
6	a) Develop the expression for response time of a photodiode.	[L3][CO4]	**[5M]**
	b) Explain the working of depletion layer photocurrent with diagram.	[L2][CO4]	**[7M]**
7	a) List the operating parameters of Si, Ge, InGaAs for PIN diode.	[L1][CO4]	**[7M]**
	b) A given silicon avalanche photodiode has a quantum efficiency of 65% at a wavelength of 900nm.Suppose 0.5μW of optical power produces a multiplied photocurrent of 10μA. Calculate the multiplication M?	[L3][CO4]	**[5M]**
8	a) Explain the digital signal transmission for an optical receiver.	[L2][CO4]	**[6M]**
	b) How the receiver configuration works in optical receiver?	[L1][CO4]	**[6M]**
9	a) Explain the mechanism of error sources and disturbance in the optical pulse detection with diagram.	[L2][CO4]	**[7M]**
	b) Demonstrate any one type of Preamplifier in detail.	[L2][CO4]	**[5M]**
10	a) Explain about the probability of error in detail.	[L2][CO4]	**[6M]**
	b) Illustrate on the quantum limit in optical receiver.	[L2][CO4]	**[6M]**

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UNIT –V
DESIGN OF ANALOG & DIGITAL SYSTEMS & WDM CONCEPTS

1	a) Discuss about error correction in digital link.	[L6][CO5]	**[5M]**
	b) Explain multi channel amplitude modulation with a neat block diagram.	[L2][CO5]	[7M]
2	a) Explain the significance of system consideration in point-to-point fiber links.	[L2][CO5]	**[7M]**
	b) Illustrate on line coding with neat diagrams.	[L2][CO5]	**[5M]**
3	a) Analyze the system performance using link power budget of digital systems.	[L4][CO5]	**[7M]**
	b) LED spectral width of 40nm has rise time of 15ns, t_{mat} is 21ns, $t_{rx}$is 14ns and t_{mod} is 3.9ns. Find total system rise time.	[L3][CO5]	**[5M]**
4	a) Summarize on system performance using rise time budget of digital systems.	[L2][CO5]	**[8M]**
	b) Explain about the operating principles of WDM.	[L2][CO5]	**[4M]**
5	a) Explain about the overview of analog links.	[L2][CO5]	**[6M]**
	b) An optical transmission system is constrained to have 500 GHZ channel spacing. How many wavelength channels can be utilized in the 1536 to 1556 nm spectral band?	[L3][CO5]	**[6M]**
6	a) Demonstrate on multichannel frequency modulation?	[L2][CO5]	**[5M]**
	b) Explain about Carrier to Noise Ratio of analog links in detail.	[L2][CO5]	**[7M]**
7	a) What is WDM? Explain the features of WDM.	[L1][CO5]	**[6M]**
	b) Explain about passive components in WDM.	[L2][CO5]	**[6M]**
8	a) Explain about solitons in detail.	[L2][CO5]	**[6M]**
	b) Illustrate on tunable sources with neat diagram.	[L2][CO5]	**[6M]**
9	a) Discuss about optical CDMA in detail with neat diagram.	[L6][CO5]	**[6M]**
	b) 2*2 biconical fiber coupler has an optical input power level of P0=400µw, the output power at the other 3 ports are P1=180µw, P2=170µw, P3=12.6nw. Find performance parameters.	[L3][CO5]	**[6M]**
10	a) List the advantages & disadvantages of using WDM in optical fiber communication system.	[L1][CO5]	**[5M]**
	b) Explain about the applications of WDM in detail.	[L3][CO5]	**[7M]**

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