Code: 20A04604c

R20

B.Tech III Year II Semester (R20) Regular Examinations August 2023

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1		Answer the following: (10 X 02 = 20 Marks)	
	(a)	Give the advantages of optical fiber communications.	2M
	(b)	A typical relative refractive index difference for an optical fiber designed for long distance transmission is 1%. Estimate the Numerical Aperture for the fiber when the core index is 1.46.	2M
	(c)	What are microscopic bends?	2M
	(d)	Name the two broad category of fiber connectors.	2M
	(e)	Differentiate Fiber splices and connectors.	2M
	(f)	Define internal quantum efficiency for LED.	2M
	(g)	Give any two requirements for optical detectors.	2M
	(h)	List the error sources in optical detection.	2M
	(i)	Name any two factors that need to be considered while designing an optical system.	2M
	(j)	List the types of WDM.	2M

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2	(a)	A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine: (i) the critical angle at the core–cladding interface; (ii) the NA for the fiber; (iii) the acceptance angle in air for the fiber.	6M
	(b)	Explain Phase velocity and group velocity.	4M
		OR	
3	(a)	Compare step index and graded index fibers.	5M
	(b)	A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 50 μm. The fiber has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fiber when it is operating at a wavelength of 1 μm.	5M
4		Explain Fiber bend losses in details.	10M
		OR	
5		A multimode graded index fiber exhibits total pulse broadening of 0.1 μs over a distance of 15 km. Estimate: (i) the maximum possible bandwidth on the link assuming no inter symbol interference; (ii) the pulse dispersion per unit length; (iii) the bandwidth–length product for the fiber.	10M
6		Explain various splicing techniques in fibers in detail.	10M
		OR	
7		Explicate the geometry of Edge emitter LED structures.	10M
8		Compare P-i-N and avalanche photodiodes.	10M
		OR	
9		With a neat schematic explain the optical receiver configuration.	10M
10		A transmitter has an output power of 0.1 mW. It is used with a fiber having NA = 0.25, attenuation of 6 dB/km and length 0.5 km. The link contains two connectors of 2 dB average loss. The receiver has a minimum acceptable power (sensitivity) of – 35 dBm. The designer has allowed a 4 dB margin. Calculate the link power budget.	10M
		OR	
11		Explain the measurement of attenuation in fibers in detail.	10M

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B.Tech III Year II Semester (R20) Supplementary Examinations January 2024

OPTICAL COMMUNICATIONS

(Electronics & Communication Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1		Answer the following: (10 X 02 = 20 Marks)	
	(a)	Define Numerical Aperture.	2M
	(b)	An optical fiber in air has an NA of 0.4. Compute the acceptance angle in air for the fiber.	2M
	(c)	Compare Stimulated Brillouin scattering and Stimulated Raman scattering.	2M
	(d)	What is Intermodal dispersion? How this can be minimized?	2M
	(e)	Two single-mode fibers with mode-field diameters of 9.2 μm and 8.4 μm are to be connected together. Assuming no extrinsic losses, determine the loss at the connection due to the mode-field diameter mismatch.	2M
	(f)	Name any two LED structures.	2M
	(g)	Define Quantum efficiency.	2M
	(h)	List the disadvantages of APDs.	2M
	(i)	Name any two major considerations involved in the Optical System Design.	2M
	(j)	Give the need for Rise time budget.	2M

PART – B

(Answer all the questions: 05 X 10 = 50 Marks)

2	(a)	Explain briefly about Skew rays.	5M
	(b)	A graded index fiber with a parabolic refractive index profile core has a refractive index at the core axis of 1.5 and a relative index difference of 1%. Estimate the maximum possible core diameter which allows single-mode operation at a wavelength of 1.3 μm.	5M
		OR	
3	(a)	Explain the single mode fibers with a neat diagram.	6M
	(b)	Determine the cutoff wavelength for a step index fiber to exhibit single-mode operation when the core refractive index and radius are 1.46 and 4.5 μm, respectively, with the relative index difference being 0.25%. (Use Vc = 2.405).	4M
4		Explain the types of Dispersion in optical fibers in detail.	10M
		OR	
5		Explain the intrinsic and extrinsic absorption loss mechanisms in Silica Glass Fibers.	10M
6		Brief about fiber misalignment in multimode optical fibers and the related losses in it.	10M
		OR	
7		Explain the structure of Surface emitter LED.	10M
8	(a)	Explain the Optical Detection Principle.	4M
	(b)	When 3×10^{11} photons each with a wavelength of 0.85 μm are incident on a photodiode, on average 1.2×10^{11} electrons are collected at the terminals of the device. Determine the quantum efficiency and the responsivity of the photodiode at 0.85 μm.	6M
		OR	
9		Explain the Fundamental Receiver Operation with its performance measures.	10M
10		Discuss about the Rise time budget and derive expression for system rise time.	10M
		OR	
11		Explain the operating principle of WDM networks and types of WDM.	10M

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