Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code: 3161005 Date:22-05-2025

Subject Name: Fiber Optic Communication

Time: 10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Describe Fiber structure with neat diagram.	**03**
	(b)	Compare Graded index fiber with Step index fiber.	**04**
	(c)	Define following: 1) Normalized frequency of fiber, 2) Mode volume for step index fiber, 3) Mode volume for graded index fiber, 4) Critical angle,5) Total internal reflection, 6) Index difference,7) Numerical Aperture.	**07**
Q.2	**(a)**	State and explain Snell's law.	**03**
	(b)	Compare Single-mode fiber with Multi-mode fiber.	**04**
	(c)	Explain and Draw block diagram of Optical fiber communication and mention functions of each block.	**07**
		OR	
	(c)	Discuss advantages and disadvantages of Optical link over conventional Copper system.	**07**
Q.3	**(a)**	What is Inter Symbol Interference? How it can be eliminated?	**03**
	(b)	Explain scattering loss in optical fiber.	**04**
	(c)	Compare LED with LASER, and give merits and demerits of both. Mention materials used in both.	**07**
		OR	
Q.3	**(a)**	Explain three operating window of fiber optics communication.	**03**
	(b)	Discuss the following for optical fibers: 1) Absorption 2) Rayleigh Scattering	**04**
	(c)	What are bending losses in optical fiber? Describe: 1) Micro bending losses, 2) Macro bending losses.	**07**
Q.4	**(a)**	List the most common type of mechanical mis alignment occurring between two joined fibers. Explain in brief anyone.	**03**
	(b)	Explain following terms: 1) Power launching, 2) Coupling efficiency.	**04**
	(c)	Explain working of RAPD with appropriate sketch.	**07**
		OR	
Q.4	**(a)**	Explain population inversion.	**03**
	(b)	Differentiate between P-I-N and Avalanche photodiodes.	**04**
	(c)	List various optical fiber splicing technique. Explain any one technique in brief.	**07**
Q.5	**(a)**	Discuss the Wavelength division multiplexing in brief.	**03**
	(b)	How does Raman amplifier work?	**04**

	(c)	Write short notes on Synchronous optical fiber networks (SONET).	**07**

OR

Q.5	**(a)**	List the key transition processes involved in laser action. Explain any one in brief.	**03**
	(b)	Describe the principle used in the photo detector.	**04**
	(c)	State methods for dispersion measurement in laboratory. Explain the experimental setup for one of them.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2024

Subject Code:3161005 Date:17-05-2024

Subject Name:Fiber Optic Communication

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Explain the three transmission windows of Optical fiber communication with diagram.	**03**
	(b)	Define the following. (Draw necessary figures and write equations if any) i) Acceptance angle and acceptance cone ii) Total internal reflection	**04**
	(c)	Discuss the ray optics representation for the skew rays and meridional rays in a step index fiber with neat and clean diagram. Derive an expression for numerical aperture and maximum acceptance angle in case of a step index optical fiber in terms of refractive indices of core and cladding material.	**07**
Q.2	**(a)**	Give comparison of intermodal and intramodal dispersion.	**03**
	(b)	A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.48 and a cladding refractive index of 1.46. Determine: (i) The critical angle at the core cladding interface. (ii)The N.A. for the fiber (iii) The acceptance angle in air for the fiber.	**04**
	(c)	Discuss fiber fabrication technique along with the schematic of a fiber drawing apparatus. Explain Outside Vapour-Phase Oxidation technique for the production of optical fiber.	**07**
		OR	
	(c)	Compare Multimode fiber with single mode fiber. A multimode step index fiber with a core diameter of 70μm and a relative index difference of 1.5% is operating at a wavelength of 0.9 μm. If the core refractive index is 1.5, Calculate the normalized frequency for the fiber and the number of guided modes. Also compute the power in the clad if the total input power is 500 mw.	**07**
Q.3	**(a)**	Mention the advantages of fiber optic cable over conventional cable.	**03**

	(b)	A continuous 15 km long optical fiber link has a loss of 1.7 dB/km. i) What is the minimum optical power level that must be launched into the fiber to maintain as optical power level of 0.3 μW at the receiving end. ii) What is the required input power if the fiber has a loss of 2.7 dB/km.	**04**
	(c)	Draw the optical power loss model diagram for a point-to-point link and explain the concept of link power budget.	**07**

OR

Q.3	**(a)**	What do you mean by dispersion?	**03**
	(b)	Mention the applications of Optical amplifier.	**04**
	(c)	With a schematic diagram explain the working of optical receiver.	**07**
Q.4	**(a)**	Define the quantum efficiency & responsivity of a photo detector.	**03**
	(b)	Make a comparison of LED and LASER diode as a light source in fiber optic communication.	**04**
	(c)	Discuss different types of Attenuation Losses related to optical fiber communication in detail.	**07**

OR

Q.4	**(a)**	Explain the working principle of star coupler.	**03**
	(b)	Explain the features of Wavelength Division Multiplexing.	**04**
	(c)	Explain the operation of Avalanche Photo Diode with neat and clean diagram.	**07**
Q.5	**(a)**	Technically explain the term Spontaneous emission and Stimulated emission.	**03**
	(b)	Explain about the surface emitter LED with neat diagram.	**04**
	(c)	Explain Optical Time Domain Reflectometry (OTDR) method with its benefits over other techniques.	**07**

OR

Q.5	**(a)**	Differentiate direct bandgap materials and indirect bandgap materials.	**03**
	(b)	What do you mean by splicing? Explain any one splicing technique with diagram.	**04**
	(c)	Classify the optical fiber according to refractive index profile and materials used to make optical fiber and explain both of them in detail.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3161005 Date:06-07-2023

Subject Name:Fiber Optic Communication

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define following terms: (1) Refractive index (2) Snell's law (3) Critical Angle	**03**
	(b)	Briefly describe the block diagram of Optical communication systems.	**04**
	(c)	Using simple ray theory, describe the mechanism for the transmission of light Within an optical fiber and show how acceptance angle is related to the fiber numerical aperture.	**07**
Q.2	**(a)**	Give the comparison of S.I and G.I fibers.	**03**
	(b)	Describe briefly the losses in optical fibers.	**04**
	(c)	An optical signal at a specific wavelength has lost 55% of its power after traversing 3.5 km of fiber. What is the attenuation in dB/km of this fiber?	**07**
		OR	
	(c)	What is dispersion in optical fiber? Classify different dispersion with reasons. Explain its effect in optical communication. How to reduce the effect of dispersion?	**07**
Q.3	**(a)**	Calculate the optical power coupled into the fiber by an optical source with a bias current of 20 mA and a forward voltage of 1.5 V. Assume an internal efficiency of the source as 2% and the coupling efficiency of 30%.	**03**
	(b)	Discuss briefly the structure of surface emitting LED with neat sketch.	**04**
	(c)	What is splicing? Explain different techniques of splicing.	**07**
		OR	
Q.3	**(a)**	Define the following terms related to photo detector. (1) Responsivity (2) Quantum efficiency (3) Cut off wavelength	**03**
	(b)	A silicon APD has a quantum efficiency of 75% at a wavelength of 900 nm. If 0.5 mw of optical power produces a multiplied photo current of 10 mA, then what is avalanche gain for this device?	**04**
	(c)	Briefly discuss the possible sources of noise in optical receivers.	**07**
Q.4	**(a)**	Give the comparison between LED and LASER.	**03**
	(b)	Explain double crucible method of fiber fabrication.	**04**
	(c)	Discuss optical power loss model for a point to point link.	**07**
		OR	
Q.4	**(a)**	What is equilibrium numerical aperture? Give the significance of the same.	**03**
	(b)	Discuss the EYE pattern diagram in brief.	**04**
	(c)	Explain Erbium Drop Power amplifiers (EDFAs).	**07**

Q.5	**(a)**	What is population inversion?	**03**
	(b)	Explain the principle of operation of Wavelength division multiplexing.	**04**
	(c)	Explain Mach-Zehnder Interferometer (MZI) Multiplexer in detail.	**07**

OR

Q.5	**(a)**	Explain the 2 x 2 fiber coupler and its function.	**03**
	(b)	Explain OTDR method with its benefits over other techniques.	**04**
	(c)	Write short notes on Synchronous optical fiber networks (SONET).	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:3161005 Date:03/06/2022

Subject Name:Fiber Optic Communication

Time:10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define: 1) Normalized frequency of fiber, 2) Mode volume for step index fiber, 3) Mode volume for graded index fiber.	**03**
	(b)	Describe Fiber structure with neat diagram.	**04**
	(c)	Draw and Explain block diagram of Optical fiber communication, and mention functions of each block.	**07**
Q.2	**(a)**	Discuss briefly numerical aperture.	**03**
	(b)	Give the comparison of S.I. and G.I. fibers.	**04**
	(c)	Draw the diagram of index profile, fiber cross-section and ray optics for the step index and graded index mono-mode and multi-mode wave propagation. Also indicate all dimensions of fiber cross-sections.	**07**
		OR	
	(c)	The radiative and non-radiative recombination life times of minority carriers in the active region of a double heterojunction LED are 60 ns, and 100 ns respectively. Determine the total carrier recombination life time and optical power generated internally, if the peak emission wavelength is 0.87 μm, and the drive current is 40 mA.	**07**
Q.3	**(a)**	Why graded index is less affected by dispersion than step index multi-mode optical fibers?	**03**
	(b)	Explain Modal noise.	**04**
	(c)	List the types of Light Emitting Diodes used in optical system and explain any one of them with required figure.	**07**
		OR	
Q.3	**(a)**	Define the following terms related to photo detector: 1) Responsivity 2) Quantum efficiency 3) Cut-off wavelength	**03**
	(b)	Discuss the following for optical fibers: 1) Absorption 2) Rayleigh Scattering	**04**
	(c)	What are bending losses in fiber optic communication? Describe: 1) Micro bending losses. 2) Macro bending losses.	**07**
Q.4	**(a)**	List the most common type of mechanical misalignment occurring between two joined fibers. Explain in brief anyone.	**03**
	(b)	Explain following terms: 1) Power launching 2) Coupling efficiency	**04**

	(c)	Differentiate between LED and Laser.	**07**
		OR	
Q.4	**(a)**	Give importance of DFB lasers used in optical transmitters.	**03**
	(b)	Differentiate between p-i-n and avalanche photodiodes.	**04**
	(c)	Discuss optical power loss model for a point-to-point link.	**07**
Q.5	**(a)**	Discuss limitations on BER in optical transmission systems.	**03**
	(b)	Describe the principle used in the photo detector.	**04**
	(c)	Discuss with the aid of a block diagram, the function of an optical fiber receiver in communication with its components.	**07**
		OR	
Q.5	**(a)**	Discuss the Wavelength division multiplexing in brief.	**03**
	(b)	Discuss the EYE pattern diagram in brief.	**04**
	(c)	Write short notes on Synchronous optical fiber networks (SONET).	**07**

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