Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013

Subject code: 1710405 **Date: 10-06-2013**

Subject Name: Fiber Optic Communication

Time: 10.30 am – 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.**

Q.1 **(a)** Compare step index and graded index fibers with respect to: Refractive index profile, Ray transmission in fiber, and Numerical aperture. What are fiber modes? Explain in brief. **07**

(b) Solve the following example: **07**

i) Find the core radius necessary for single-mode operation at 1320 nm of a step-index fiber with core index 1.480 and cladding index 1.478. What are the numerical aperture and maximum acceptance angle of this fiber?

ii) A point source of light is 12 cm below the surface of a large body of water (n=1.33 for water). What is the radius of the largest circle on the water surface through which the light can emerge?

Q.2 **(a)** Define signal attenuation. Write a brief note on basic attenuation mechanisms in fiber optics. **07**

(b) A 6 km long optical link consists of multimode step-index fiber with a core refractive index of 1.5 and a relative refractive index difference of 1%. Find: **07**

i) the delay difference between the slowest and fastest modes at the fiber end;

ii) the rms pulse broadening due to intermodal dispersion on the link;

iii) the maximum bit rate B_T that may be obtained without substantial errors on the link assuming only intermodal dispersion;

iv) the bandwidth-length product of this fiber assuming the maximum bit rate equals the bandwidth.

OR

(b) Define power signal-to-noise ratio S/N of an optical receiver. An InGaAs pin photodiode has the following parameters at 1500 nm: I_D = 1.0 nA, ɖ = 0.95, R_L = 500 ɋ, and the surface leakage current is negligible. The incident optical power is 500 nW (-33 dBm), and the receiver bandwidth is 150 MHz. Compare the various noise currents of direct detection type optical receiver. **07**

Q.3 **(a)** Explain the following terms with reference to optical communication: **07**

i) Mode-Field Diameter ii) Group velocity iii) Material dispersion

(b) Discuss pulse broadening in graded-index fiber. What is mode-coupling? **07**

OR

Q.3 **(a)** Explain the structure of Distributed feedback (DFB) laser diode with neat sketch. **07**

(b) Answer the following questions: **07**

i) Describe the following terms related to photo detector with their significance: Responsivity, Response Time, and Cut off wavelength.

ii) Draw and explain the three key transition processes involved in laser action.

Q.4	**(a)**	Describe the configuration of a surface emitting LED. Also find the expression of internal quantum efficiency and optical power generated by LED.	**07**
	(b)	Write short note on WDM.	**07**

OR

Q.4	**(a)**	Write short note on Raman amplifier.	**07**
	(b)	Discuss 2×2 fiber coupler. Also define various performance parameters of an optical coupler.	**07**
Q.5	**(a)**	Explain operating principle of an optical time-domain reflectometer (OTDR). List out OTDR field applications.	**07**
	(b)	Answer the following questions: i) Describe the effects of self-phase modulation in optical fiber communications. ii) Consider a $Ga_{1-x}Al_xAs$ laser with x=0.07. Find the peak emission wavelength.	**07**

OR

Q.5	**(a)**	List out the nonlinear effects in optical fiber transmission link that degrade network performance. Describe Stimulated Brillouin Scattering (SBS) in brief.	**07**
	(b)	Answer the following questions: i) Explain power penalties in optical link in brief. ii) A GaAs laser diode has a 500-µm cavity length which has an effective absorption coefficient of 10 cm^{-1}. For uncoated facets the reflectivities are 0.32 at each end. What is the optical gain at the lasing threshold?	**07**

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