Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE Sem-VI Summer Exam 2012

Subject code: 161005 **Subject Name: Optical Communication**

Date:19/05/2012 **Total Marks: 70** **Duration: 10:30am to 1.00pm**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Define the following terms: **03**
(i) Acceptance angle(ii)Optical bandwidth(iii)Bulk recombination lifetime

(b) Justify the following statements: **04**
(i) Signal distortion mechanism in optical fiber limits the information rate of the signal
(ii) A mode remains guided as long as propagation factor β satisfies the condition $n_2k < \beta < n_1k$

(c) Calculate the link power budget to construct an optical link of 15KM and a bandwidth of 100Mb/s.Components are chosen with following characteristics: **04**
Receiver sensitivity is -50dBm,fiberloss is 2dB/KM and a transmitter launch power of 0dBm,source and detector coupling loss of 1dB each..It is anticipated that 10 splices are required with each of loss of 0.4dB.Determine whether the system operates with sufficient power margin or not..

(d) Compare Step and Graded index fibers **03**

Q.2 **(a)** Define Numerical Aperture and derive its expression for the step index fiber. A multimode step index fiber has a refractive index difference of 1% and a core refractive index of 1.5.The number of modes propagating at a wavelength of 1.3µm is 1600.Calculate the acceptance angle, numerical aperture and the diameter of the fiber core **07**

(b) Explain briefly: **07**
(i) Variation of refractive index as a function of doping concentration stating the dopants added to silica
(ii The Fabrication of the glass preform by Vapour axial deposition method and state the advantages offered by this method

OR

(b) Explain with neat sketches possible lensing schemes for optical source to fiber coupling efficiency and discuss the efficient scheme. **07**

Q.3 **(a)** Explain the phenomenon and the conditions for the total internal reflection of an optical ray incident at an angle θ at the interface between two media. **04**

(b) Calculate the optical power coupled into the fiber by an optical source with a bias current of 20mA and a forward voltage of 1.5V.Assume an internal efficiency of the source as 2% and the coupling efficiency of 30%. **03**

	(c)	Define signal attenuation and how is it mathematically expressed. Explain the following: a. Scattering Losses. b. Bending losses.	**07**
		OR	
Q.3	**(a)**	Explain the advantages of the optical communication system using optical fiber over conventional copper system as a transmission link. State the optical transmission windows.	**04**
	(b)	Explain the 2x2 Fiber Coupler and its function	**03**
	(c)	How does material dispersion occur in an optical fiber. Obtain the expression for group delay τ_{mat} resulting from the material dispersion and from this, deduce the relation for the pulses spread σmat in terms of material dispersion Dmat (λ).	**07**
Q.4	**(a)**	Explain the principle ,characteristics and operation of avalanche photodiode.	**04**
	(b)	A photo diode has a quantum efficiency of 70% when photons of energy 1.5×10^{-19}Joules are incident upon it. Calculate(i) Operating wavelength(ii)Responsivity of the photodiode and(iii)Incident optical power required to maintain a photocurrent of 3μA.	**03**
	(c)	Explain following with respect to laser diodes: (i) The structure with neat and labeled sketch (ii) Modes of the cavity (iii) Threshold conditions for lasing.	**07**
		OR	
Q.4	**(a)**	Explain the significance of the following terms related to the optical source (i)Optical confinement(ii)Carrier confinement (iii) Internal Quantum efficiency. Describe with a neat and labeled sketch, the construction of an Edge emitting LED	**07**
	(b)	Derive the relation for the optical power launched from a surface emitting LED into a graded index fiber.	**04**
	(c)	A Laser diode has lateral $\Phi=0^\circ$ and transverse $\Phi=90^\circ$ half beam widths of $2\theta=40^\circ$ and 20° respectively. What are the transverse and lateral power distribution coefficients for this device.	**03**
Q.5	**(a)**	Explain rise time budgeting in digital fiber optic system	**06**
	(b)	Discuss the Cut back technique for attenuation measurement	**05**
	(c)	Show the configurations of SONET/SDH Rings.	**03**
		OR	
Q.5	**(a)**	Explain the principle of operation of (i) EDFA (ii) Wavelength division multiplexing.	**07**
	(b)	Write a brief note on Fiber Splicing techniques	**07**

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