Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 710405N **Date: 08-01-2014**

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)** Explain : **08**

(i) Laser diode modes and threshold conditions

(ii) Outside Vapour oxidation method of fabrication of optical fiber.

(b) A DWDM optical transmission system is designed to have 100GHz channel spacings..How many wavelength channels can be utilized in the 1536-1556nm spectral band. **02**

(c) Justify the statement **04**

(i) For the design of single mode fiber, V should be nearly equal to 2.4

(ii) Waveguide dispersion is predominant in single mode fiber.

Q.2 **(a)** State the system requirements of an optical fiber link and explain **09**

(i) Design procedure of link budget of an optical fiber with the help of power loss model

(ii) Rise Time Budget analysis for dispersion limit

(b) Make a power budget for a short haul system of 5km long, with the required data rate is 20Mbps,BER is $1X10^{-9}$ errors/bit and it is operating at λ=850nm.The Si PIN photodiode has a receiver sensitivity of about -42dBm. GaAlAs LED can couple 50μW into multimode fiber with a core diameter of 50μm.The connector loss is 1dB per connector. Splices are required at each km with 0.5dB per splicing loss and fiber attenuation loss for the fiber is 3.5 dB/km. **05**

(OR)

(b) A soliton transmission system operates at 1550nm with fibers that have a dispersion of 1.5ps/(nm-km) and a effective core area of $50\mu m^2$.Find the peak power required for fundamental solitons that have a 16psFWHM width. Use $n_2=2.6x10^{-16}$ cm^2/W. What are the dispersion length and soliton period? What is the required peak power for 30- ps pulses **05**

Q.3 **(a)** Give the difference between surface emitters and edge emitters. Describe with a neat and labeled sketch the construction of **09**

(i) Edge emitting LED

(ii) High radiance surface emitting LED

(b) A laser diode has lateral ($\Phi=0^0$) and transverse ($\Phi=90^0$) half power beam width of $2\theta= 60^0$and 30^0 respectively.What are the transverse and lateral power distribution coefficients of this device? **05**

(OR)

Q.3	**(a)**	How does material dispersion occur in an optical fiber?Obtain the expression for group delay τmat resulting from the material dispersion and from this deduce the relation for the pulses spread σmat in terms of material dispersion Dmat (λ) and σ_λ, length L, the distance traveled in the optical waveguide	**09**
	(b)	An LED operating at 850nm has a spectral width of 45nm.What is the pulse spreading in ns/Km due to material dispersion.?What is the pulsespreading when a laser diode having a 2nm spectral width?	**05**
Q.4	**(a)**	Compare PIN and avalanche photodiodes with respect to construction,principle of operation and characteristics.	**07**
	(b)	Explain (i) OTDR .(ii) DWDM	**07**
		(OR)	
Q.4	**(a)**	Describe (i) Optical Gating Wavelength Converters (ii) Fiber Bragg Grating .	**07**
Q.4	**(b)**	Discuss the three different mechanisms responsible for the absorption losses of optical energy.	**07**
Q.5	**(a)**	Discuss effects of nonlinear processes in optical fiber on the system performance. Discuss (i) Self phase modulation (ii) Stimulated Raman Scattering.	**09**
	(b)	A detector operating at 800nm produces an output current of 80μA for an incident light beam of power 800μW. Calculate the quantum efficiency and responsivity of the detector.	**05**
		(OR)	
Q.5	**(a)**	For a semiconductor optical amplifiers, explain (i) External pumping of current (ii) Derive expression for (i) steady state gain per unit length (ii) Small signal gain per unit length(iii) Signal Gain	**09**
	(b)	A 2X2 biconical tapered fiber coupler has an input power level of P_0 =60 μW,P_2 = 55 μW,P_3 = 4.3nW.Find the four coupling parameters:Splitting ratio,Excess loss,Insertion loss and return loss.	**05**

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