M.Tech

Electronics & Communication Engineering

FIRST SEM.EXAMINATION, 2012-13

Subject: *OPTICAL COMMUNICATION* Paper Code: MEC-104

Time: 3hrs Max.Marks:100

Note: (1) Attempt all questions.

(2)All questions are of equal marks.

(3)Notations used have usual meaning.

(4)Assume any relevant data, if missing.

Q.1.*Attempt any two parts of the following:* *{10X2=20}*

(a) Explain nature of light? Deduce the condition for total internal reflection of light in a *fiber*. Calculate the numerical aperture of a step index having $n_1 = 1.48$ and $n_2 = 1.46$. What is the maximum entrance angle for this fiber if outer medium is air.

(b) Draw design curve of the fractional refractive index difference, Δ versus the core radius 'a' for a silica –core ($n_1 = 1.458$) , single mode fiber to operate at 1300nm suppose the fiber we select from this curve has a 5μm core radius. Is the fiber still single mode at 820nm? Which modes exist in the fibre at 820nm?

(c) Write the advantages of optical communication. Also explain the fiber structure.

Q.2.*Attempt any two parts of the following:* *{10X2=20}*

(a) what is signal distortion? How it limits the performance of optical communication? Discuss & derive the expression for mechanism by which distortion is caused in optical optical fibre communication.

(b) Explain the mechanism of intermodal dispersion in a multimode step index fiber. Show that the broadening of light pulse δT_s is given as

$$\delta T_s = \frac{L(NA)^2}{2n_1 c}$$

Where L is the fiber length, NA is the numerical aperture of the fiber, n_1 is the core refractive index and c is the light velocity in vaccum.

(c) Calculate for single mode & multimode fibres , the critical radius of curvature at which large bending losses occur in step index fibre of core refractive index of 1.45 & relative index difference of 3% at an operating wavelength of 1.5μm & core radius of 5μm.

Q.3.*Attempt any two parts of the following:* *{10X2=20}*

(a) Explain the semiconductor injection laser. Find its internal quantum efficiency and show how it is related to the differential external quantum efficiency.

(b) What is the major advantage of heterojunction LED over a homostructured LED? Calculate the cutoff wavelength of GaAs material with optical energy gap of 1.4 eV at 273 °K.

(c) Explain the efficiency and modulation capability of light emitting diode. A planer LED is fabricated from GaAs whisch has a refractive index 3.6. Calculate the optical power for the device if the transmission factor at the crystal air interface is 0.68.

Q.4.*Attempt any two parts of the following:* *{10X2=20}*

(a) What is Equilibrium numerical Aperture? Explain various lensing schemes for optical fibers and why are they used?

(b) Explain the major elements of an optical fiber receiver. Describe the usage of preamplifier and technique for automatic gain control in APD receiver.

(c)Discuss the most common type of line coding used in digital fiber optical communication including non-return-to-zero (NRZ), return-to-zero (RZ) and biphase.

Q.5. *Attempt any two parts of the following:* *{10X2=20}*

(a) Explain WDM and its various components. Why is there a need of WDM at all?

(b) A 2 X 2 biconical tapered fiber coupler has an input optical power level of $P_0 = 200\mu W$. The output powers at the other three ports are $P_1 = 90\mu W$, $P_2 = 85\mu W$ and $P_3 = 6.3nW$. Calculate (i) Coupling ratio (ii) Excess loss (iii) Insertion loss (iv) Crosstalk.

(c) Write short notes on any two of the following

(i) Rise-Time Budget

(ii)Multichannel Transmission

(iii) OTDR