AMIETE – ET (OLD SCHEME)

Code: AE24   Subject: OPTO ELECTRONICS
Time: 3 Hours   OPTICAL COMMUNICATIO
JUNE 2011   Max. Marks: 100

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1   **Choose the correct or the best alternative in the following:**   **(2×10)**

a. A 1552.5 nm wavelength signal has a frequency of

   (A) 193.1 GHz   **(B)** 19.31 MHz
   (C) 193.1 THz   **(D)** None

b. Optical Spectrum ranges from

   (A) 50 nm to 100μm   **(B)** Ultraviolet to Far infrared
   (C) Both   **(D)** None

c. Basic building block and first level of SONET signal hierarchy (STS-1) has a bit rate (in Mb/s) of

   (A) 51.84   **(B)** 155.52
   (C) 622.08   **(D)** 1244.16

d. A wave front is locus of all points in the wave train which have the same

   (A) Amplitude   **(B)** Frequency
   (C) Phase   **(D)** All of the above

e. Conditions required for total internal reflection can be determined by

   (A) Cosine Law   **(B)** Snell's Law
   (C) μ-Law   **(D)** None

f. Diffusion length (L_n) and Carrier lifetime (τ_n) are related as

   (A) $L_n = (D_n \tau_n)^{1/3}$ **(B)** $L_n = (D_n \tau_n)^{2/3}$
   (C) $L_n = (D_n \tau_n)^{-1}$ **(D)** $L_n = (D_n \tau_n)^{1/2}$

g. The emission pattern of edge emitter LED as compared to surface emitter LED is

(A) Less Directional
(B) Equally Directional
(C) More Directional
(D) may be equal or less Directional

h. Which is incorrect about Fiber Splicing

(A) Permanent or semi permanent joint
(B) Used to create Long optical links
(C) V-groove mechanical splice yields a permanent joint
(D) None

i. Responsivity (R) is related to Quantum Efficiency (η) by

(A) $R = I_p / P_o$
(B) $R = P_o / I_p$
(C) $R = I_p P_o$
(D) $R = (I_p / P_o)^2$

j. The relationship between Numerical Aperture (NA) and relative refractive index difference (Δ) for meridional rays is

(A) $NA = n_1 (2 \Delta)^{1/2}$
(B) $NA = n_1 (4 \Delta)^{1/2}$
(C) $NA = n_1 (3 \Delta)^{1/3}$
(D) $NA = n_1 (2 \Delta)^2$

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. With the help of a Block Diagram, elaborate the major elements of an optical fiber transmission link. **(8)**

b. Explain in brief :
(i) Refractive Index   (ii) Total Internal Reflection
(iii) Plane of Incidence   (iv) Snell's Law   **(4×2)**

Q.3 a. Explain Linear and Non Linear Scattering Losses in optical fibers. **(8)**

b. Consider a 30 Km long optical fiber that has an attenuation of 0.8 dB/Km at 1300 nm. Find the optical output power P_{out} (in dBm), if 200 μW of optical power is launched into the fiber. **(8)**

Q.4 a. (i) List the major requirements for an optical fiber emitter.
(ii) Define heterojunctions and explain its application in Injection Lasers. **(4+4)**

b. Elaborate on the principle of laser action with the help of Energy State diagram and derive the Einstein relations. **(8)**

Q.5 a. Explain how intermodal distortion leads to signal degradation? **(6)**

b. (i) Derive the equation for internal quantum efficiency and the optical power generated internally in an LED. **(6)**

(ii) The radiative and non radiative recombination lifetimes of the minority carriers in the active region of a double heterojunction LED are 60 ns and 100 ns respectively. Determine the total carrier recombination lifetime and the power internally generated within the device when the peak emission wavelength is 0.87 μm at a drive current of 40 mA. **(2+2)**

Q.6 a. Explain p-i-n photodiode principle and structures giving factors that limit the speed of its response. **(8)**

b. Enlist the several criteria used for receiver performance calculations and describe them briefly. **(8)**

Q.7 a. Explain Avalanche Photodiodes giving their benefits and drawbacks. **(12)**

b. Explain the importance of Block-codes in line coding. **(4)**

Q.8 a. Discuss about the losses encountered in a passive linear-bus coupler consisting of a cascade of a two directional couplers. **(8)**

b. Give the block schematic of a four channel OTDM system which transmits 16 G bits/s. **(8)**

Q.9 a. Discuss the physical layer aspects of SONET/SDH. **(8)**

b. Explain the optical power loss model for a point to point link and show how link loss budget is derived. **(8)**