

AMIETE – ET (OLD SCHEME)

Code: AE24

Subject: OPTO ELECTRONICS AND
OPTICAL COMMUNICATION

Time: 3 Hours

DECEMBER 2010

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 half an hour 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. One of the following is not a technique for fabrication of glass optical wave guide
- (A) Vapor phase oxidation method
(B) Direct melt method
(C) Epi-taxial layering method
(D) Chemical vapour deposition technique
- b. The transmission losses per km of optical fiber cables are about
- (A) 10 dB (B) 1 dB
(C) 6 dB (D) 0.1 dB
- c. Identify which of the following is/are involved in lasing action.
- (A) Photon absorption. (B) spontaneous emission.
(C) stimulated emission. (D) all of above
- d. Which of the following material is not suitable for making an LED?
- (A) GaAs (B) Silicon
(C) InGaAsP (D) GaAlAs
- e. Wave propagation in optical fibers is due to
- (A) reflection (B) diffraction
(C) total internal reflection (D) refraction
- f. Multimode fibers must be used with
- (A) LED source. (B) LCD source.
(C) LASER source. (D) any light source

- g. Optical communication uses which portion of EM spectrum
- (A) IR (B) VHF
(C) HF (D) UHF
- h. For a step-index fiber the NA across the core
- (A) varies (B) will be opposite
(C) is constant (D) is independent
- i. One of the causes for material dispersion in fibers is
- (A) group delay (B) velocity of wave
(C) none (D) material choice
- j. Polarization inversion is a property found in
- (A) LED (B) LASER
(C) Photodiode (D) FET

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

- Q.2** a. Discuss the basic optical communication system. Give advantages of optical fibers over metallic cables. (8)
- b. Compute the cutoff parameter and number of modes supported by a fiber $n_1(\text{core})=1.5$ and $n_2(\text{cladding})=1.48$, core radius= $25\mu\text{m}$ and operating wave length= $0.85\mu\text{m}$. (8)
- Q.3** a. List the requirements needed for selecting materials for optical fibers. What are major considerations on which cable design is dependent? (8)
- b. An optical signal travelling a distance of 500 meter in a fiber losses 75% of its input power, Find the loss in dB/km of the fiber? (8)
- Q.4** a. Find the fractional refractive index change and largest core size for single mode propagation of a Graded index fiber having a parabolic profile with $n_1=1.47$ and $n_2=1.46$, $\lambda=1300\text{nm}$. (8)
- b. What are three factors on which the modulation bandwidth of LED dependent. What are the advantages of LEDs? (8)
- Q.5** a. Minority carriers in the action region of LED have radiative and non-radiative lifetime of 40 ns and 60 ns respectively. Find total carrier recombination life time and power internally generated within the device. The peak emission wavelength is $0.85\mu\text{m}$ with a drive current of 35 mA. (8)
- b. Explain the following terms in context of photo detector:
(i) Quantum efficiency (ii) Responsivity (8)

- Q.6** a. (i) Calculate the responsivity of a detector with quantum efficiency of 15% at 850nm. (4)
(ii) Show that a GaAs photodetector will cease to operate above 0.87 μm if its band gap energy is 1.43eV at room temperature. (4)
- b. Draw equivalent circuit for a digital optical fiber receiver including various noise sources. (8)
- Q.7** a. Find out the optical power budget for an optical link of 10 km and bandwidth 20 Mb/s with the following components chosen with respective characteristics shown against each. Receivers sensitivity 40 dBm (at 20 Mb/s), fiber loss 2 dB/km and transmitter launch power into the fiber is 8 dBm the detector coupling loss is 1dB. In addition, 8 splices each of loss 0.4 dB are required. Determine whether system operates with sufficient power margin? (8)
- b. Describe with a suitable diagram an injection LASER shunt drive circuit? (8)
- Q.8** a. A silicon p-i-n photodiode incorporated into an optical receiver has a quantum efficiency of 60% when operating at wavelength of 0.850 μm . The dark current in the device is 3nA and the load resistance is 4K Ω . The incident optical power at this wavelength is 200 nW and the post detection bandwidth of the receiver is 5MHz. Compare the shot noise generated in the photodiode with the thermal noise in load resistor at a temperature of 25°C. (8)
- b. With the help of diagram, explain four channel OTDM fiber system? (8)
- Q.9** a. What are the factors considered in planning for SONET network architecture? Draw the SONET hub network with all its basic network elements. (8)
- b. Write short notes on the following:-
(i) Line codes
(ii) AGC and equalisation. (4+4)