ROLL NO. _____

Code: AE24 Subject: OPTO ELECTRONICS & OPTICAL COMMUNICATION

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **OCTOBER 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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. The loss of optical power as light travels along a fiber is called as

(A) attenuation **(B)** scattering
(C) absorption **(D)** dispersion

b. What makes optical fibers immune to EMI?

(A) They transmit signal in as light rather than electric current.
(B) They are too small for magnetic fields to introduce current in them.
(C) Magnetic fields cannot penetrate glass of the fiber.
(D) They are readily shielded by outer conductors in cable.

c. When would optical fibers be used in an Ethernet type LAN?

(A) Never, the standard calls for coaxial cable.
(B) To extend transmission distance to reach remote terminals.
(C) Routinely, the standard allows for optical fiber.
(D) When transmission speeds exceed 50 Mbit/s.

d. What method allows a large number of independent, selectable channels to exist on a single fiber?

(A) Time Division Multiplexing
(B) Phase Modulation
(C) Frequency Division Multiplexing
(D) Analog Modulation

e. Which of the following is not a NON-LINEAR effects in optical fiber?

(A) Self phase modulation **(B)** Four wave mixing
(C) Stimulated raman scattering **(D)** Modal Noise

f. Edge Emitting and Surface Emitting are types of

(A) LASER **(B)** LED
(C) PHOTODETECTOR **(D)** COUPLER

g. The two main sources of noise in photodiodes without internal gain are

(A) Flicker noise and shot noise
(B) Internal and external noise
(C) White noise and Gaussian noise
(D) Dark current noise and Quantum noise

h. ZMD point means

(A) Zero Mode Dispersion **(B)** Zero Material Dispersion
(C) Zero Minimum Dispersion **(D)** Zero Mode Determination

i. A multiplexing technique where instead of each channel occupying a given wavelength, frequency or time slot, the light information is transmitted using a coded sequence of pulses. Each channel employs a specific code to transmit and recover original signal. The technique is

(A) Optical TDM **(B)** Optical FDM
(C) Optical CDMA **(D)** Optical WDM

j. An optical fiber coupler is

(A) A device which stores light
(B) A device which amplifies light
(C) A device which is used as a wavelength changer
(D) A device which distributes light from main fiber to one or more fibers.

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

Q.2 a. Explain the following LED characteristics (Any **TWO**):
(i) Optical O/P power
(ii) Output Spectrum
(iii) Modulation Bandwidth **(8)**

b. Calculate the ratio of threshold current densities at $20^{\circ}C$ and $80^{\circ}C$ for AlGaAs injection laser with $T_o = 160K$. **(6)**

c. Give any two advantages of LED over LASER. **(2)**

Q.3 a. Draw the block diagram of a digital fiber optic receiver and also a full equivalent circuit for a digital optical fiber receiver including various noise sources. **(6)**

b. A photodiode has quantum efficiency of 50% at 0.90 μm. Calculate responsivity and received optical power if mean photocurrent is 10^{-6} A. **(6)**

c. Explain population inversion. **(4)**

Q.4 a. A typical relative refractive index difference for an optical fiber designed for long distance transmission is 1%. Estimate the NA and solid acceptance angle in air for the fiber when core index is 1.46. Further, calculate the critical angle at the core cladding interface within the fiber. It may be assumed that concepts of geometric optics hold for the fiber. **(8)**

b. Explain the following:
(i) Snell's law (ii) Polarization
(iii) Modal noise (iv) Splicing **(8)**

Q.5 a. What are graded index fibers? How they are designed to reduced intermodal dispersion? What is chromatic dispersion? **(6)**

b. Give any three advantages of communication through fiber optics than any other means of communication. **(6)**

c. What are the various possible structures of optical networks and which are the three optical networking layers? **(4)**

Q.6 a. What are various multiplexing techniques in optical communication? What is SONNET? **(8)**

b. A lens coupled surface emitting LED launches 190 μW of optical power into a multimode step index fiber when a forward current of 25 mA is flowing through the device. Determine the overall power conversion efficiency when the corresponding forward voltage across the diode is 1.5V. **(8)**

Q.7 a. Draw a neat diagram of surface emitter LED and explain. **(8)**

b. For a step index fiber the following properties are given
$a = 4\mu m$, $n_1 = 1.5$, $n_2 = 1.47$
Determine the cutoff wavelength for the fiber. **(8)**

Q.8 a. Define the terms Avalanche effect and reach through. With a neat schematic explain the operation of RAPD. **(8)**

b. What do you understand by optical power budgeting? **(8)**

Q.9 Write short note on any **TWO**:
(i) Dispersion modified and Dispersion Compensating fibers.
(ii) Optical TDM.
(iii) Fiber couplers.
(iv) Line coding. **(8+8)**