ROLL NO. _____

Code: AE24 Subject: OPTO ELECTRONICS & OPTICAL COMMU[illegible]ON

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **DECEMBER 2011** **Max. Marks: 100**

NOTE: There are 9 Questions in all.

- **Please write your Roll No. at the space provided on each page immediately after receiving the Question Paper.**
- **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. Light exhibit what kind of wave motion?

(A) Longitudinal **(B)** Transverse
(C) Turbulent **(D)** A periodic

b. How does the speed of light in the fiber, compared to the speed of light in air?

(A) It is slower in fiber **(B)** It is faster in fiber
(C) It is same in both **(D)** Light do not propagate in air

c. The numerical aperture relates to which of the following characteristic?

(A) Physical size of fiber
(B) Strength of fiber
(C) Maximum angle within the fiber acceptance core
(D) Speed of light in fiber

d. What are the two methods through which light is transmitted through the fiber?

(A) Ray theory & Mode theory **(B)** Ray theory & Photon theory
(C) Ray theory & Quantum theory **(D)** Mode theory & Photon theory

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

(A) Attenuation **(B)** Scattering
(C) Absorption **(D)** Dispersion

f. What are the two basic categories of fiber splices?

(A) Glass and Plastic **(B)** Metal and ceramic
(C) V-groove and Rotary **(D)** Mechanical and fusion

g. What are the two basic classifications of fiber optic links?

(A) High speed & low speed **(B)** RZ & NRZ line coded
(C) Digital & Analog **(D)** Amplitude & Frequency Modulated

h. Which of the following type of noise is introduced by fiber optic receivers?

(A) Thermal noise only **(B)** Shot noise only
(C) Quantum noise only **(D)** All the three

i. The gain of an APD can be changed in what way?

(A) By changing data rate of incoming optical signal
(B) By changing the reverse bias voltage
(C) By changing modulation format of incoming signal
(D) By changing input power of optical signal

j. What does the term Lasing threshold mean?

(A) The lowest drive current level at which output of laser results primarily from simulated expression
(B) The polish or cut surfaces at each end of active stripe in the laser
(C) The shortest wavelength the laser emits
(D) The front step of laser chip.

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

Q.2 a. Draw a digital optical fiber link using a semiconductor laser source and avalanche photo diode (APD) detector and explain the use of Amplifier and Equalizer. **(8)**

b. For a Step Index fiber, the following properties are given: a=4 μ m, n_1=1.5, n_2=1.47. Determine the cut-off wavelength for the fiber. **(8)**

Q.3 a. What do you understand by polarization in fibers (single mode) and what are polarization maintaining fibers? **(6)**

b. What is intermodal dispersion? In which type of fibers does it occur? A multimode step index fiber has a numerical aperture of 0.3 and a core refractive index of 1.45. The material dispersion parameter for the fiber is 250 ps nm^{-1} km which makes material dispersion, the totally dominant intramodal dispersion mechanism. Calculate the total rms pulse broadening per km when the fiber is used with a LED source of rms spectral width 50 nm. **(8)**

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

Q.4 a. Derive the differential external quantum efficiency of a laser. **(8)**

b. Give any four characteristics of LED. **(8)**

Q.5 a. Name any **TWO** LED structures. **(1)**

b. A photodiode has a quantum efficiency of 65% when photons of energy 1.5×10^{-19} J are incident upon it. (i) At what wavelength is the photodiode operating? (ii) Calculate the incident optical power required to obtain a photocurrent of 2.5 μA when the photodiode is operating as described above. **(10)**

c. What are the various noise sources in an optical fiber receiver? **(5)**

Q.6 a. Draw a 4 channel OTDM system in fiber and explain how we can extend time division multiplexing by optically combining a number of lower speed electronic baseband digital channels. **(8)**

b. Draw a subcarrier multiplexed system in fiber. Mention its disadvantages. **(8)**

Q.7 a. What do you understand by optical power budgeting? **(8)**

b. An optical fiber system is to be designed to operate over an 8 km length without repeaters. The rise times of chosen components are:
(i) Source (LED): 8 ns
(ii) Fiber: Intermodal: 5 ns/km
(iii) Pulse broadening (intermodal: 1 ns/km
(iv) Detector (p-i-n photodiode): 6 ns. **(8)**

Q.8 Differentiate between:
(i) Phase and group velocity
(ii) Intermodal & Intramodal dispersion
(iii) Ray theory and mode theory for fibers
(iv) Numerical Aperture and V-number **(16)**

Q.9 Write short notes on any **TWO**:
(i) Fiber connectors
(ii) Population Inversion
(iii) Dispersion Shifted fibers
(iv) PIN-photo diode. **(8+8)**