ROLL NO. _____

Code: AE75 Subject: OPTOELECTRONICS AND COMMUNICATION

AMIETE – ET (Current Scheme)

Time: 3 Hours **June 2018** **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. In Graded index fibers, the phase-velocity spread is the least when the index profile approximates:
(A) a parabola **(B)** a hyperbola
(C) a linear ramp **(D)** an exponential decrease

b. For an acceptance angle of 30^0, the numerical aperture would be
(A) 0.5 **(B)** 0.866
(C) $\sqrt{2}$ **(D)** $1 / \sqrt{2}$

c. For a given free space wavelength the normalized fiber frequency was calculated to be 4.5. The number of modes that the fiber would be able to sustain are
(A) 8 **(B)** 16
(C) 32 **(D)** None of these

d. Material dispersion of an optical fiber vanishes if:
(A) Refractive index of the core varies linearly with wavelength
(B) Refractive index of the core remains constant with wavelength
(C) Both **(A)** and **(B)**
(D) None of these

e. Which among the following may minimize the inhomogenities for Mie scattering reduction?
(A) Extrusion Control
(B) Increase in relative R.I. difference
(C) Removal of imperfections due to glass manufacturing process
(D) All of these

f. The Peak emission wavelength of InGaAsP LED (band gap of 0.97 eV) is
(A) 850 nm **(B)** 950 nm
(C) 1270 nm **(D)** 1550 nm

g. Speckle noise is associated with intensity fluctuation in
(A) LED **(B)** PIN
(C) APD **(D)** LD

h. To employ multi channel access in GSM, users are given different
(A) time slots **(B)** bandpass filters
(C) handsets **(D)** None of these

i. If the errors are corrected at _____end/s, it is known as 'Forward Error Correction' (FEC)?
(A) Transmitter **(B)** Receiver
(C) Both **(A)** and **(B)** **(D)** None of these

j. In SDH, STM level of electrical signaling has the data rate of
(A) 51.84 Mbps **(B)** 155.52 Mbps
(C) 622.08 Mbps **(D)** None of these

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

Q.2 a. What is weakly guided mode approximation? Discuss its role to find linearly polarized solutions of our wave equation. **(4)**

b. Discuss advantages & disadvantage together with material used for Helide glass fiber and Plastic fiber **(4+4)**

c. A GRIN fiber with parabolic refractive index profile core has a refractive index at the core axis of 1.5 and relative index difference at 1%. Calculate maximum possible core diameter that allows single mode operation at $\lambda = 1.3$ μm **(4)**

Q.3 a. Define Modal birefringence and beat length in single mode fibers. **(4)**

b. Discuss the various dispersions occurring in optical fiber communication system. Derive the pulse broadening due to intermodal dispersion. How it can be minimized? **(8)**

c. Explain the polarization mode dispersion (PMD) in optical fiber. **(4)**

Q.4 a. Explain the population Inversion, spontaneous absorption, spontaneous emission, stimulated emission with proper diagrams. **(6)**

b. Define the modulation characteristics of LED. Distinguish between optical 3 dB Bandwidth and electrical 3 dB Bandwidth **(6)**

c. An APD has a quantum efficiency of 50% at a wavelength of 500 nm in the absence of Multiplication. If the device is operated with a reverse bias to give a multiplication factor of 8, calculate the responsivity. **(4)**

Q.5 a. What are the requirements of good optical fiber connector? Write the expression of Power coupled from the LED to (i) step index and (ii) graded index optical fiber. **(7)**

b. A certain fiber has an attenuation of 1.5 dB/ km at 1300 nm. If 0.5 mW of optical power is initially launched into the fiber, what is the power level in microwatts after 8Km? **(4)**

c. Draw diagrams of the following lensing schemes
(i) Rounded ended (ii) Non imaging Microsphere
(iii) Imaging sphere (iv) Cylindrical lens
(v) Taper ended fiber **(5)**

Q.6 a. A photodetector has a quantum efficiency of 80% at 1000 nm. A radiation of optical power 0.01 watt/m at this wavelength is incident on the device which has a receiving area of 1 mm. The detector has a dark current of 5 nA and a shunt resistance of 10 ohms. If the bandwidth of operation is 100 MHz, calculate the power SNR of the detector. **(9)**

b. Discuss the performance parameters of the analog and digital receivers. **(7)**

Q.7 a. Define beat stacking, CSO and CTB **(4)**

b. What are the parameters that influence the CNR of optical receivers operating in multi-channel analog optical systems? **(6)**

c. Show how analog and digital signal can be simultaneously sent by frequency division multiplexing on different subcarrier frequencies? **(6)**

Q.8 a. What is point to point communication link and what are its applications? What are the different point to point network topologies? Discuss any four point to point network topologies and its features. **(8)**

b. Explain NRZ, Manchester & RZ line codes in optical link with an example. **(8)**

Q.9 a. Consider a commercially available 32 × 32 single mode coupler made from cascade of 3-dB fused fiber 2 × 2 couplers where 5% of the power is lost in each element. Calculate excess loss, splitting loss and total loss for this coupler. **(8)**

b. Compare STS-N SONET frame with STM-N SDH frame and obtain the line rate of STS-1 and STM-1. **(8)**