ROLL NO. _____

Code: AE75 Subject: OPTOELECTRONICS AND COMMUNICATION

AMIETE – ET

Time: 3 Hours **DECEMBER 2014** **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. If the refractive indices of core and cladding of a fiber are 1.54 and 1.5 respectively, then the acceptance angle will be

(A) 20.43^o **(B)** 32.04^o
(C) 0 **(D)** 1

b. If the refractive index of core in step index fiber is 1.5 and the relative refractive index difference between the core cladding of the fiber is

(A) 9^o **(B)** 79^o
(C) 100^o **(D)** None of these

c. A step-index fiber with 5μm diameter has core-cladding refractive indices of 1.45 and 1.447 respectively. How many modes can be propagated? Inside the fiber, if $\lambda = 1\mu m$.

(A) 1 **(B)** 0
(C) 10 **(D)** None of these

d. The attenuation of light in an optical fiber is estimated to be 2.2dB/km. What fraction of the initial intensity remains after a distance of 2km?

(A) 0 **(B)** 0.633
(C) 0.363 **(D)** None of these

e. A 25 km long multimode step index fiber with $n_1 = 146$ is operated at $\lambda = 1.3\mu m$. What is the permissible maximum bit rate?

(A) 1.5×10^6MB/s **(B)** 5.1×10^{-6}
(C) 1 **(D)** None of these

f. A double hetrojunction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and non-radiative recombination times of 30 and 100 ns respectively. What is the internal power level, if the drive current is 40 mA.

(A) 22.9 mW **(B)** 29.2 mW
(C) 9.22 mW **(D)** None of these

g. Photons of energy 1.53×10^{-19} J are incident on a photodiode which has a responsivity of 0.65A/W. If the optical power level is 10μW, then the photo current generated is

(A) 65μA **(B)** 5.6μA
(C) 6.5μA **(D)** 56μA

h. A 2×2 biconical tapered fiber coupler has an input power of 200μW. If the output powers at the other three ports are P_1 = 90μW, P_2 = 85μW and P_3 = 6.3 nW, the coupling ratio is

(A) 64.8% **(B)** 48.6%
(C) 100% **(D)** None of these

i. What is the wavelength of radiation given out by a laser with E_2-E_1=3Ev.

(A) 441 mm **(B)** 144 mm
(C) 144 nm **(D)** 441 nm

j. A photo diode is constructed of GaAs, which has band gap energy of 1.43 eV at 300K. The cut off wavelength is

(A) 869 nm **(B)** 968 nm
(C) 698 nm **(D)** None of these

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

Q.2 a. Draw the functional block diagram of an optical fiber communication system. Mark the component typical to OFC. List the merits, demerits and applications of optical fibers. **(10)**

b. Calculate the cut off parameter and the number of modes supported by a fiber with core Refractive Index 1.54 and cladding is 1.5, Core has a radius of 25μm and operates at 1300nm. **(6)**

Q.3 a. Briefly explain the reasons for pulse Broadening due to material dispersion in optical fibre. **(8)**

b. Define the following terms: **(3+3+2)**
(i) Scattering losses in optical fibers
(ii) Mode Coupling
(iii) Bending losses

Q.4 a. Explain the principle and operation of a photo detector. List the requirements of a good optical source. **(8)**

b. Photon energy of 1.5×10^{-19} J is incident on a photodiode, having a quantum efficiency of 85%. Calculate the wavelength at which the diode is operational and the incident optical power to obtain a photocurrent of 5μAmp. **(4)**

c. Discuss the factors responsible for limiting the speed of response of photodiode. **(4)**

Q.5 a. (i) With neat sketches, discuss the mechanical misalignments which occurs between two fibers.
(ii) Suggest 5 possible lens schemes used to improve source of fiber coupling efficiency. **(8)**

b. What are optical fiber connectors? Discuss some principal requirements for a good connector design. **(8)**

Q.6 a. What is an optical preamplifier? Derive an equation for the signal to noise ratio at the output of an optical preamplifier. **(8)**

b. For an optical receiver show that at least 27 photons/bits are required to maintain BER $\leq 10^{-12}$ **(8)**

Q.7 a. Discuss the cause and effect of signal degrading effects in optical fibers. **(8)**

b. Define quantum efficiency and responsivity of optical detectors. Find these quantities in an optical detector at 0.85μm, when 3×10^{11} electrons. **(8)**

Q.8 a. Explain the following terms in context with point-to-point links for Digital Transmission:- **(3+3+2)**
(i) Link Power Budget
(ii) Rise Time Budget
(iii) Short Wavelength Band

b. Enlist all the techniques employed for correction and detection purpose. Explain one for each. **(8)**

Q.9 a. Briefly explain the four sub layers of SONET. **(8)**

b. Define WDM. With the help of Schematic diagram, explain the operational principles of WDM. **(8)**