ROLL NO. ___________

Code: AE75 Subject: OPTOELECTRONICS AND COMMUNICATION

AMIETE – ET

Time: 3 Hours **DECEMBER 2013** **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. A light ray is incident form glass to air. If n_1=1.5 and n_2=1, the critical angle is

(A) 41.81^0 **(B)** 81.41^0
(C) 14.18^0 **(D)** 18.14^0

b. For a fiber cable n_{core} = 1.5 and $n_{cladding}$ = 1.48. The numerical aperture is

(A) 0.442 **(B)** 0.244
(C) 0 **(D)** 1

c. An optical fiber has a diameter of 50 μm, n_1=1.48, n_2=1.46 and λ=0.82μm. The number of modes will be

(A) 3801 **(B)** 1083
(C) 100 **(D)** 1000

d. A multimode step index optical fiber with relative refractive index difference of 1.5% and core refractive index 1.48 is to be used for single mode operation. If λ=0.85 μm, the maximum core diameter will be

(A) 1.3 m **(B)** 1.3 mm
(C) 1.3 μm **(D)** 2.6 μm

e. A fiber has an average loss of 3dB/km at 900 nm. The length over which the power decreases by 50% is

(A) 1km **(B)** 2km
(C) 3km **(D)** 4km

f. The radiative and non radiative recombination life times of minority carriers in the active region of a heterjunction LED are 60 nsec and 90 nsec respectively. The total carrier recombination life time is

(A) 63 nsec **(B)** 36 nsec
(C) 10 nsec **(D)** 100 nsec

g. A PIN photodiode is fabricated by GaAs has bandgap energy of 1.43eV at 300ºk. It's upper cut-off wavelength is

(A) 867nm **(B)** 768nm
(C) 10nsec **(D)** None of these

h. For a 2 ×2 fiber coupler, if the input power is 200 μW and throughput power is 90 μW, the insertion loss will be

(A) 6.43 dB **(B)** 4.63 dB
(C) 3.4 dB **(D)** None of these

i. Which of the following fibers are suitable for WDM of signals:

(A) Dispersion optimized **(B)** Dispersion – shifted
(C) Dispersion flattened **(D)** Any fiber

j. Photons having an energy of 1.53×10^{-19} joules are incident on a photodiode having responsivity of 0.65A/W. If the output power is 10 μW, the generated photocurrent is

(A) 6nA **(B)** 6.5μA
(C) 6mA **(D)** None of these

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

Q.2 a. List out limitations of optical fiber communication systems. **(6)**

b. A step index multimode fiber with a numerical aperture of a 0.20 supports approximately 1000 modes at an 850nm wavelength.
(i) What is the diameter of its core?
(ii) How many modes does the fiber support at 1320nm? **(6)**

c. A fiber has normalized frequency V = 26.6 and the operating wavelength is 1300nm. If the radius of the fiber core is 25 μm, compute the numerical aperture. **(4)**

Q.3 a. Explain the pulse dispersion in optical fibers with suitable diagram. **(6)**

b. A continuous 12 km long optical fiber link has a loss of 1.5 dB/km. **(6)**
(i) What is the minimum optical power level that must be launched into the fiber to maintain an optical power level of 0.3 μW at the receiving end?
(ii) What is the required input power if the fiber has a loss of 2.5 dB/km?

c. An LED operating at 850 nm has a spectral width of 45 nm. What is the pulse spreading in ns/km due to material dispersion? **(4)**

Q.4 a. Show that the optical power emitted from an LED is $\frac{P_{int}}{n(n+1)^2}$ where P_{int} is the internally generated optical power, n is the reference index of LED material. **(8)**

b. Describe the emission patterns of different types of LED and LASER diodes. **(8)**

Q.5 a. Briefly explain the source–to-fiber power launching. **(8)**

b. A single mode fiber has a normalized frequency V = 2.40, a core refractive index $n_1 = 1.47$, a cladding refractive index $n_2 = 1.465$ and a core diameter 2a = 9 μm. Let us find the insertion losses of a fiber joint having a lateral offset of 1 μm. **(8)**

Q.6 a. Draw and explain the schematic diagram of a typical optical receiver. **(8)**

b. Explain the circuit diagram of high impedance bipolar transistor amplifier. List the benefits of a transimpedance amplifier. **(8)**

Q.7 a. Write short notes of any **TWO**. **(16)**
(i) Carrier power
(ii) Photodetector and pre-amplifier noises
(iii) Relative intensity noise (RIN)

Q.8 a. Write short notes on **(8)**
(i) RZ codes
(ii) Block codes

b. With help of neat sketch. Explain the basic setup for an automatic-repeat-request (ARQ) error correction scheme. **(8)**

Q.9 a. Describe (i) SONET/SDH Networks (ii) Frame format of SONET/SDH **(10)**

b. A 2×2 biconical tapered fiber coupler has an input optical power level of P_0 = 200 μW. The output powers at the other three ports are P_1 = 90 μW, P_2 = 85μW and P_3 = 6.3 μW. Find:-
(i) Coupling ratio
(ii) Excess loss **(6)**