

Code: AE75 Subject: OPTOELECTRONICS AND COMMUNICATION

**AMIETE – ET (Current Scheme)**

Time: 3 Hours

**December - 2017**

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. Laser is based on the principle of
 

(A) Spontaneous emission	(B) Stimulated emission
(C) Radiated emission	(D) All of these
- b. To transform optical power into electrical power which physical effect is utilized in photon-detector?
 

(A) pyroelectric	(B) bolometric
(C) Photo-emissive	(D) Both (A) and (B)
- c. A 1×10 coupler has an input signal 0 dBm. What is the power level at each output port?
 

(A) 0 dBm	(B) –10 dBm
(C) –3 dBm	(D) –1 dBm
- d. If the core/cladding dimensions of an optical fiber are given by 50/125  $\mu\text{m}$ , the fiber type would be \_\_\_\_\_.
 

(A) Multimode graded index	(B) Single mode graded index
(C) Multimode step index	(D) Single mode step index
- e. A 25 km long multimode step index fiber with  $n_1 = 1.46$  is operated at  $\lambda = 1.3\mu\text{m}$ . What is the permissible maximum bit rate?
 

(A) $5.1 \times 10^{-6}$	(B) $5.1 \times 10^6$ MB/s
(C) 1	(D) None of these
- f. The cladding which surrounds the fiber core
 

(A) is used to reduce optical interference	(B) is used to protect the fiber
(C) ensure that the refractive index remains constant	(D) acts to guide the light in the core
- g. A light ray is incident from glass to air. If  $n_1=1.5$  and  $n_2=1$ , the critical angle is
 

(A) $14.18^\circ$	(B) $81.41^\circ$
(C) $41.81^\circ$	(D) $18.14^\circ$
- h. CDMA is \_\_\_\_\_.
 

(A) Carries division multiple access	(B) Code division multiple access
(C) Code diversion multiple access	(D) Coding multiple access

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- i. WDM can be implemented by  
 (A) Mach-Zehnder interferometer (B) Fiber Bragg grating  
 (C) Arrayed waveguide grating (D) All of these
- j. White noise consist of  
 (A) flat spectrum (B) series spectrum  
 (C) no spectrum (D) None of these

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

- Q.2** a. Explain the structure of a fiber. Why is refractive index of cladding is slightly less than that of core? What is graded index fiber? (8)
- b. Calculate the cut off wavelength and the number of modes supported by a fiber with core Refractive Index 1.54 and cladding refractive index 1.5. Core has a radius of 25 $\mu$ m and operates at 1300nm. (8)
- Q.3** a. Briefly explain the reasons for pulse broadening due to material dispersion in optical fiber. (8)
- b. Describe the effect of mode coupling on pulse distortion. (8)
- Q.4** a. Derive the expression for quantum efficiency and power in a light emitting diode. (8)
- b. A P-N Photodiode has a quantum efficiency of 50% at a wavelength of 0.9  $\mu$ m. Calculate: (i) its responsivity at 0.9 $\mu$ m  
 (ii) the received optical power if mean photocurrent is  $10^{-6}$  amp  
 (iii) the corresponding number of received photons at this length (8)
- Q.5** a. List a few principal requirements of a good connector design. What are the different connector types? (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  $2a = 9 \mu$ m. Let us find the insertion losses of a fiber joint having a lateral offset of 1  $\mu$ m. (8)
- Q.6** a. What are the important requirements of an optical receiver? Explain the Trans impedance amplifier stage in optical receiver. (8)
- b. Draw and explain the circuit of High Impedance pre-amplifier using FET. (8)
- Q.7** a. With neat schematic, explain basic concept of subcarrier multiplexing. (8)
- b. Derive the carrier to noise ratio. (8)
- Q.8** a. Explain link design equations in point to point communication link based on power budget and rise time budget consideration. (8)
- b. Why is line coding an important consideration within digital optical fiber system design? (8)
- Q.9** a. Explain Semiconductor optical Amplifier with a neat diagram and compare it with EDFA. (8)
- b. Describe (i) SONET/SDH Networks (ii) Frame format of SONET/SDH (8)