

Code: AE75 Subject: OPTOELECTRONICS AND COMMUNICATION**AMIETE – ET (Current Scheme)****Time: 3 Hours****JUNE 2015****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. Which one of the following is not a reason for losses in optical fibers _____ .
- (A) Impurities (B) Microbending
(C) Attenuation (D) Stepped index operation
- b. If the core/cladding dimensions of an optical fiber are given by 50/125μm, the fiber type would be _____ .
- (A) Single mode step index (B) Single mode graded index
(C) Multimode step index (D) Multimode graded index
- c. Which of the following photodetector has the highest multiplication factor _____ .
- (A) P-N diode (B) Avalanche photodiode
(C) PIN diode (D) Photo transistor
- d. Splice is a _____ .
- (A) Non permanent connection of two fibers
(B) Non separable junction of two fibers
(C) A process of cutting fibers at the ends
(D) A process of breaking fiber into two
- e. Silica based optical fibers have an attenuation minimum near _____ .
- (A) 800 nm (B) 1020 nm
(C) 1310 nm (D) 1550 nm
- f. The desirable property/properties of optical source for fiber optic communication should be _____ .
- (A) High radiance (B) Fast response
(C) High efficiency (D) All of these

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g. An optical amplifier has a noise figure of 3.2dB. If Input signal has a SNR of 50dB, then the output SNR will be _____.

- (A) 46.8dB
(C) 66.8dB

- (B) 56.8 dB
(D) 76.8dB

h. Transmission bit rate of basic SONET signal is STS1 = _____.

- (A) 51.84 Mb/s
(C) not specified

- (B) 501.84Mb/s
(D) 51.84 Hz

i. SCM stands for _____ .

- (A) Systematic code multiplexing
(C) Standard code multiplexing

- (B) Sub carrier multiplexing
(D) Sub code multiplexing

j. A rise time budget analysis is a convenient method for_____.

- (A) Determining the attenuation limitation of optical fiber link
(B) Determining the total budget of an optical fiber link
(C) Determining the dispersion limitation of optical fiber link
(D) Finding the length of fiber optic cable

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

Q.2 a. Discuss the significance of any FOUR of the following terms in optical fibers:-
(8)

- (i) Snell's law
(ii) Acceptance angle
(iii) Numerical Aperture
(iv) Mode theory
(v) Skew rays

b. A typical relative refractive index difference for an optical fiber designed for long distance transmission is 1% and its core index is 1.46, then
(i) Estimate its Numerical Aperture
(ii) Calculate the Critical Angle at the core-cladding interface within the fiber.
(8)

Q.3 a. What is dispersion? How does it play an important role in determining information capacity of a waveguide? Classify the different types of dispersions. (8)

b. Discuss the design-optimization characteristics of single-mode fibers with suitable diagrams. (8)

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- Q.4** a. A double heterojunction InGaAsP LED emitting at peak wavelength of 1310nm has radiative and nonradiative recombination times of 30ns and 100ns respectively. The drive current is 40 mA. Find (i) the bulk recombination lifetime and (ii) internal quantum efficiency. **(8)**
- b. Discuss the basic architecture of a vertical-cavity surface emitting single mode laser with the help of a suitable diagram. **(8)**
- Q.5** a. A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiber that has a refractive index of 1.48. If the fiber end and the source are in close physical contact. Then find (i) the Fresnel reflection at the interface, and (ii) the power loss **(8)**
- b. With the help of diagrams, explain the various lensing schemes for coupling improvement. **(8)**
- Q.6** a. Explain any **TWO** the following terms with reference to optical receivers:
(i) Intersymbol interference
(ii) Bit error rate
(iii) Quantum Limit
(iv) Extinction Ratio **(8)**
- b. Draw and explain the circuit of High Impedance pre-amplifier using FET. **(8)**
- Q.7** a. Explain the basic concept of Sub Carrier Multiplexing with a neat diagram. **(8)**
- b. What is RIN? What are the reflection effects on RIN? **(8)**
- Q.8** a. What are the key system requirements needed for analyzing a transmission link in optical fiber technology? **(8)**
- b. What is Rise Time Budget? How is it useful in determining dispersion limitation of an optical fiber link? **(8)**
- Q.9** a. Explain Semiconductor optical Amplifier with a neat diagram and compare it with EDFA. **(8)**
- b. Consider an InGaAsP SOA with $w = 5\mu\text{m}$ and $d = 0.5\mu\text{m}$. Given that $v_g = 2 \times 10^8 \text{ m/s}$, if a $1.0\mu\text{W}$ optical signal at 1550nm enters the device. Then;
(i) What is the photon density?
(ii) What is the steady state gain per unit length? **(8)**