

**FIBER OPTIC COMMUNICATION
(ECEN 3241)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) An absorption caused by valance electrons in the silica material from which the fibers are manufactured
(a) UV absorption (b) Ion resonance absorption
(c) Modal dispersion (d) IR absorption
 - (ii) Type of fiber that has the highest modal dispersion.
(a) Step index single mode (b) step index multimode
(c) graded index Single (d) graded index multimode.
 - (iii) Calculate the energy of the infrared light at 1.55 μm
(a) 0.5 eV (b) 1.55 eV (c) 0.8 eV (d) None.
 - (iv) Light in a graded index fiber is guided by
(a) Total Internal Reflection (b) Refraction
(c) Both (a) & (b) (d) None.
 - (v) Which of the following materials is not suitable for making an LED?
(a) GaAs (b) Si (c) InGaAsP (d) AlGaAS.
 - (vi) Given that, Ge has a bandgap of 0.67 eV, what is the maximum wavelength that will be absorbed by it?
(a) 7080 nm (b) 4560 nm (c) 1850 nm (d) 1100 nm.
 - (vii) A p-n photodiode, on an average, generates one electro-hole pair per five incident photons at a wavelength of 900 nm. Assuming all the photo-generated electrons are collected, what is the quantum efficiency of the diode?
(a) 20% (b) 30% (c) 40% (d) 50%
 - (viii) EDFA operates at the following windows
(a) Around 1300 nm (b) Around 1550 nm
(c) Around 980 nm (d) None.

- (ix) The scheme of WDM is similar to
(a) FDM for RF transmission (b) TDM (c) SDM (d) OTDM.
- (x) SONET sends ----- number of frames per second
(a) 1000 (b) 2000 (c) 4000 (d) 8000.

Group – B

2. (a) Define (i) Numerical Aperture, (ii) normalized frequency or V number of optical fiber.
- (b) Explain how the multimode optical rays are propagated through the Graded-Index optical fiber with a suitable diagram.
- (c) A cylindrical step index fiber has a core diameter of 100 μm and refractive index of 1.5. The cladding has a refractive index of 1.46. The source is operating at a wavelength of 0.95 μm . Estimate: (a) the normalized frequency for the fiber (b) the number of guided modes.

$$(2 + 2) + 3 + 5 = 12$$

3. (a) Derive the expression for material dispersion in optical fiber.
- (b) Define bending loss and connector loss for optical fiber.
- (c) What are the causes of attenuation?

$$4 + (2 + 2) + 4 = 12$$

Group – C

4. (a) With neat diagram, explain the operation of edge-emitting double hetero structure LED.
- (b) Define Internal Quantum efficiency & External quantum efficiency of an LED.
- (c) With neat diagram, explain the operation of edge-emitting double hetero structure LED. Also mention its advantages over surface emitting double hetero structure.

$$4 + 2 + (4 + 2) = 12$$

5. (a) What is population inversion? Find the threshold condition for lasing operation.
- (b) Describe the operation of Injection LASER diode. What is index guiding?

$$(3 + 3) + (4 + 2) = 12$$

Group – D

6. (a) Derive the relation between quantum efficiency and responsivity of a photodiode.
- (b) Discuss the operation of Avalanche photo detector with appropriate diagrams.

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- (c) An APD has a quantum efficiency of 75% at 900nm. When illuminated with optical power of 0.8 μ W at this wavelength, it produces an output photocurrent of 10 μ A. Calculate the multiplication factor of the diode.

$$4 + 5 + 3 = 12$$

7. (a) Explain the principle of operation of WDM with relevant block diagrams.
(b) With the help of energy level diagram, explain the principle of operation of EDFA.

$$5 + 7 = 12$$

Group – E

8. (a) What do you mean by SONET? Describe the different layers in SONET.
(b) Explain the frame structure of SONET.
(c) Name different network topologies.

$$(2 + 4) + 4 + 2 = 12$$

9. Write short notes on (Any Three):

$$(3 \times 4) = 12$$

- (i) Multimode Fiber
(ii) Step index optical fiber.
(iii) SOA
(iv) FDDI.

Department & Section	Submission Link
ECE	https://docs.google.com/forms/d/e/1FAIpQLSf5zN5SYo22N-mG-2_zTVRyAXc3w3anPeJR3R7dmjRHWVlp8Q/viewform?usp=sf_link