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**B.TECH**  
**(SEM V) THEORY EXAMINATION 2022-23**  
**OPTICAL COMMUNICATION**

**Time: 3 Hours****Total Marks: 100**

**Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.  
2. Any special paper specific instruction.

**SECTION A**

**1. Attempt all questions in brief. 2 x 10 = 20**

- (a) Define goos- haenchen shift in optical fiber waveguide.
- (b) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine the critical angle at the core-cladding interface.
- (c) What are the causes of attenuation in optical communication?
- (d) Define the polarization of light in optical communication.
- (e) A lens-coupled surface-emitting LED launches 190  $\mu\text{W}$  of optical power into a multimode step index fiber when a forward current of 25 mA is flowing through the device. Determine the overall power conversion efficiency when the corresponding forward voltage across the diode is 1.5 V.
- (f) What are the advantages of LED light?
- (g) When  $3 \times 10^{11}$  photons each with a wavelength of  $0.85 \mu\text{m}$  are incident on a photodiode, on average  $1.2 \times 10^{11}$  electrons are collected at the terminals of the device. Determine the quantum efficiency.
- (h) Define optical detector in optical communication.
- (i) Define quantum limit in optical communication.
- (j) What is mean by Eye pattern in optical communication?

**SECTION B**

**2. Attempt any three of the following: 10 x 3 = 30**

- (a) A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.50 and a cladding refractive index of 1.47. determine: (i) the critical angle at the core-cladding interface; (ii) the  $NA$  for the fiber; (iii) the acceptance angle in air for the fiber.
- (b) What is mean by dispersion? Describe the Intramodal dispersion.
- (c) What are the drawbacks of LEDs in comparison with injection lasers? Describe various type of LED structure with their diagram.
- (d) A germanium  $p-i-n$  photodiode with active dimensions of  $100 \times 50 \mu\text{m}$  has a quantum efficiency of 55% when operating at a wavelength of  $1.3 \mu\text{m}$ . The measured dark current at this wavelength is 8 nA. Calculate the noise equivalent power and specific detectivity for the device. It may be assumed that dark current is the dominant noise source.
- (e) Describe the homodyne detection and heterodyne detection.

## SECTION C

3. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Draw and explain the basic block diagram of optical fiber communication system and also describe the advantage of optical fiber communication.
  - (b) What is graded index fibers in optical fiber communication? A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 50  $\mu\text{m}$ . The fiber has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fiber when it is operating at a wavelength of 1  $\mu\text{m}$ .
4. Attempt any *one* part of the following: 10 x 1 = 10
- (a) What is kerr effect in optical fiber communication? Describe the fiber bend losses in optical fiber.
  - (b) Describe the various types of nonlinear scattering losses in optical wave guide.
5. Attempt any *one* part of the following: 10 x 1 = 10
- (a) The radiative and non radiative recombination lifetimes of the minority carriers in the active region of a double-heterojunction LED are 80 ns and 100 ns respectively. Determine the total carrier recombination lifetime and the power internally generated within the device when the peak emission wavelength is 0.87  $\mu\text{m}$  at a drive current of 40 mA.
  - (b) Describe the optical feedback and laser oscillation in optical waveguide.
6. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Describe the working principle of PIN photodiode with proper diagram.
  - (b) Define the mode of laser and describe the threshold condition for laser oscillation.
7. Attempt any *one* part of the following: 10 x 1 = 10
- (a) Explain the basic concept of Free Space Optics (FSO) based communication System with its application in fiber optics.
  - (b) Describe the multichannel & multiplexing transmission techniques in fiber optics.