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**B.TECH**
**(SEM. VII) THEORY EXAMINATION 2018-19**
**OPTICAL COMMUNICATION**

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

**Note: 1.** Attempt all Sections.
**2.** Assume any missing data.

**SECTION A**

**1. Attempt *all* questions in brief.** **2 x10 = 20**

a. State Goos-Hanchen effect?
b. What is the principle used in the working of fibers as light guides?
c. What are step index and graded index fibers?
d. What is pulse broadening?
e. Discuss the advantage and disadvantage of LED.
f. What is threshold current density of LASER?
g. What type of noise present in optical receiver?
h. Define avalanche effect.
i. What are the methods used for error detection and correction in an optical link design?
j. Write short note on Power penalties?

**SECTION B**

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

a. What do you mean by Acceptance angle of an optical fiber? Derive an expression for numerical aperture of optical fiber. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.5 and cladding refractive index of 1.47 determine Critical angle at core cladding interface, NA for the fiber and Acceptance angle.
b. Describe the mechanism of intermodal dispersion in a multimode step index fiber. Show that the total broadening of light pulse $\delta T_s$ due to intermodal dispersion in a multimode step index fiber may be given by $\delta T_s = \frac{L(NA)^2}{2cn_1}$ where L is the fiber length, NA is numerical aperture, $n_1$ is the core refractive index and c is the velocity of light.
c. Discuss Hetero-Junction in Light Emitting Diode (LED). Explain the efficiency and modulation capability of LED.
d. Explain the physical principle of APD. What is the temperature effect on avalanche gain? Describe Automatic gain control using OP-AMP.
e. Draw and explain avalanche photodiode receiver and derive expression for SNR.

## SECTION C

**3. Attempt any one parts of the following:** **10 x 1 = 10**

a. Sketch the block diagram of optical fiber communication system. With the suitable ray diagram, explain the propagation of skew rays in the optical waveguide and compare it with meridional rays.

b. What is phase velocity & group velocity? Derive the relation between group velocity & group index of the guide.

**4. Attempt any one parts of the following:** **10 x 1 = 10**

a) Describe with the aid of simple ray diagrams:
(i) the multimode step index fiber,
(ii) the single mode step index fiber.
Compare the advantages and disadvantages of these two types of fiber for use as an optical channel.

b) What is Modal Birefringence? The beat length in a single- mode optical fiber is 9 cm when light from an injection laser with a spectral line width of 1 nm and a peak wavelength of 0.9μm is launched into it. Determine the modal birefringence and estimate the coherence length in this situation. In addition calculate the difference between the propagation constants for the two orthogonal modes and check the result

**5. Attempt any one parts of the following:** **10 x 1 = 10**

a) Explain the working principle of LED. How the quantum efficiency of a LED is defined? List out various parameters which are needed to be optimized for getting maximum output power from the LED.

b) Explain the principle of semiconductor lasers and, draw the emission characteristic. A ruby LASER contains a crystal length 4cm with refractive index of 1.78.The peak emission wavelength from the device is 0.55μm. Determine the number of longitudinal modes and their frequency separation.

**6. Attempt any one parts of the following:** **10 x 1 = 10**

a) Discuss the various factors which effect the launching of optical signal into fiber. Determine the power coupled into step index fiber whose $n_1 = 1.48$, $n_2 = 1.46$, if surface emitting LED radiates 150μW of power.

b) Explain the working of PIN photodiode. A p-i-n photodiode has a quantum efficiency of 55% at a wavelength of 0.9 micrometer. Calculate:

(i). Its responsivity at 0.9 micrometer.

(ii). The received optical power if the mean photocurrent is $10^{-8}$ A.

(iii). The corresponding number of received photons at this wavelength.

**7. Attempt any one parts of the following:** **10 x 1 = 10**

a) Define bit error rate (BER) of digital optical receiver. Obtain its expression for binary receiver assuming noise distribution to be Gaussian.

b) Draw a block diagram and explain the principle of coherent detection method in optical fiber.