

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

Time: 3 Hours**Total Marks: 70****Note:** Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief. 2 x 7 = 14

- (a) What is acceptance angle? Discuss its importance.
- (b) Define rayleigh scattering and mie scattering.
- (c) Write the physical principal of photodiode.
- (d) Write the difference between semiconductor diode and LED.
- (e) List/Name the techniques used for coupling the optical sources (LED/LASER) to the fiber.
- (f) What is the difference between step index fiber and graded index fiber?
- (g) Define dark current noise.

SECTION B

2. Attempt any three of the following: 7 x 3 = 21

- (a) (i) Explain the concept of electromagnetic modes in relation to a planer optical waveguide.
(ii) Define Phase velocity and group velocity.
- (b) (i) What do you mean by the acceptance angle of an optical fiber? Derive an expression for numerical aperture of optical fiber.
(ii) 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, determines critical angle at core cladding interface, numerical aperture for the fiber and acceptance angle.
- (c) (i) Write the advantages of optical fiber communication system.
(ii) Using simple ray theory, describe the mechanism for the transmission of light within an optical fiber.
- (d) What is material dispersion? Explain in detail.
Two step index fibers have the following characteristics
(i) A core refractive index of 1.5 with a relative refractive index difference of 0.2% and an operating wavelength of 1.55 μm .
(ii) A core refractive index the same as (i) but a relative refractive index difference of 3% and an operating wavelength of 0.82 μm .
Estimate the critical radius of curvature at which large bending losses occur in both cases.
- (e) (i) What are step index fibers? Explain the ray transmission and refractive index profile for single mode step index fiber and multi mode step index fiber with the help of suitable diagram.
(ii) A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5 % is operating at a wavelength of 0.85 μm . If the core refractive index is 1.48. Calculate normalized frequency for the fiber and number of guided modes.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7
- (a) What are linear and non linear scattering losses? Explain Stimulated brillouin scattering and stimulated raman scattering.
 - (b) Explain the principle of operation of a laser diode and derive an expression for lasing threshold current density.
4. Attempt any *one* part of the following: 7 x 1 = 7
- (a) What are the general requirements of an optical source in optical fiber communication?
Explain the principle of operation of LED.
 - (b) Name the material used for the fabrication of LED. Explain the efficiency and modulation capability of LED
5. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Write the principle of avalanche photodiode. Explain the working of avalanche photodiode receiver with the help of necessary diagram and derive the expression for signal to noise ratio.
 - (b) Describe the factors which limit the speed of response of a photodiode and show the impact of change in temperature over avalanche multiplication factors/internal gain.
6. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Write a short note on any two of the following
 - (i) Responsivity
 - (ii) Quantum efficiency
 - (iii) Absorption coefficient
 - (b) What is the function of an optical detector? Draw an optical receiver configuration with different possible structures for front end amplifier. Explain the different types of error/noise sources in an optical receiver.
7. Attempt any *one* part of the following: 7 x 1 = 7
- (a) Define the bit error rate (BER) of digital optical receiver. Obtain its expression for binary receiver, assuming Gaussian noise distribution.
 - (b) (i) Discuss about optical power penalties.
(ii) Explain link power budget. A 5 km length optical fiber link has a fiber cable which has attenuation of 4dB/km and connector losses at the source and detector are 4 & 3.5, considering no dispersion on the link, calculates the total channel loss.