

Code No: R204104A

R20

SET - 1

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY GURAJADA VIZIANAGARAM**  
**IV B. Tech I Semester Regular/Supplementary Examinations OCT/NOV 2025**  
**OPTICAL COMMUNICATION**

(ECE)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions. **ONE** Question from **Each unit**

All Questions Carry Equal Marks

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**UNIT-I**

1. a) State how mode-field diameter is related to the single mode fiber. What are the propagation modes in them? [7M]  
b) What is numerical aperture of an optical fiber? Deduce an expression for the same [7M]  
(OR)
2. a) Draw a neat diagram and explain the ray theory behind the optical fiber communication with a special mention about the total internal reflection, Acceptance angle and Numerical aperture [7M]  
b) Explain about transmission of light through graded index fiber with neat diagrams [7M]

**UNIT-II**

3. a) Show that the intermodal dispersion that occurs in a multimode step index fiber causes signal degradation in fibres. [7M]  
b) Explain attenuation caused by absorption, scattering losses and bending losses. [7M]  
(OR)
4. a) How a waveguide dispersion affects the performance of the transmission in an optical fiber? Explain. [7M]  
b) Show that numerical aperture is dependent on the refractive indices of core and cladding through proper derivation [7M]

**UNIT-III**

5. a) What is splicing? Explain about fusion splicing. [7M]  
b) An optical fiber has a core refractive index of 1.5. Two lengths of the fiber with smooth and perpendicular (to the core axes) end faces are butted together. Assuming the fiber axes are perfectly aligned, calculate the optical loss in dB at the joint (due to Fresnel reflection) when there is a small air gap between the fiber end faces [7M]  
(OR)
6. a) A single mode fibre operating at the wavelength of  $1.3 \mu\text{m}$  is found to have a total material dispersion of 2.81 ns and a total waveguide dispersion of 0.495 ns. Determine the received pulse width and approximate bit rate of the fiber if the transmitted pulse has a width of 0.5 ns [7M]  
b) Illustrate various types of misalignments resulting in losses while splicing and joining optical fibers. [7M]

**UNIT-IV**

7. a) A practical surface LED has  $50 \mu\text{m}$  diameter emitting area and operates at peak modulation current of 100 mA. What is BW of GaAs LED having a  $2.0 \mu\text{m}$  active area thickness assume  $B_r/10^{-10} \text{ cm}^3/\text{s}$   $\delta = 10^4 \text{ cm/sec}$ . [7M]  
b) Derive the expressions for photo detector noise and detector response time [7M]

(OR)

8. a) What is an avalanche photodiode? What are the differences between APDs and PIN devices? [7M]
- b) A planar LED is fabricated from gallium arsenide which has a refractive index of 3.6. (i) Calculate the optical power emitted into air as a percentage of the internal optical power for the device when the transmission factor at the crystal-air interface is 0.68. (ii) When the optical power generated internally is 50% of the electrical power supplied, determine the external power efficiency [7M]

**UNIT-V**

9. a) Explain the procedure to determine the maximum allowable R2 and NR2 data rates from rise time budget analysis. [7M]
- b) What are the underlying principles of the WDM techniques? [7M]
- (OR)
10. a) What is the significance of system consideration in point-to-point fiber links? Explain in detail. [7M]
- b) Design an optical fiber link for transmitting 15 Mb/sec of data for a distance of 4 km with BER of  $10^{-9}$ . [7M]

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