

Roll No.

Total No. of Questions : 09]

[Total No. of Pages : 02

B. Tech. (Sem. – 7th/8th)
OPTICAL FIBER COMMUNICATIONS
SUBJECT CODE : EC - 404

Paper ID : [A0329]

[Note : Please fill subject code and paper ID on OMR]

Time : 03 Hours

Maximum Marks : 60

Instruction to Candidates:

- 1) Section - A is **Compulsory**.
- 2) Attempt any **Four** questions from Section - B.
- 3) Attempt any **Two** questions from Section - C.

Section - A

(10 × 2 = 20)

- Q1) a)** The value of the normalized frequency parameter (V) relates the core size with mode propagation. When single mode fibers propagate only the fundamental mode, what is the value of V?
- b) The number of modes propagated in a multimode fiber depends on core size and numerical aperture (NA). If the core size and the NA decrease, will the number of modes propagated increase or decrease?
- c) Modal dispersion affects the bandwidth of multimode systems. It is essential to adjust what three fiber properties to maximize system bandwidth.
- d) Silica (pure glass) fibers are used because of their low intrinsic material absorption at the wavelengths of operation. This wavelength of operation is between two intrinsic absorption regions. What are these two regions called? What are the wavelengths of operation for these two regions?
- e) Extrinsic (OH⁻) absorption peaks define three regions or windows of preferred operation. List the three windows of operation?
- f) Scattering losses are caused by the interaction of light with density fluctuations within a fiber. What are the two scattering mechanisms called when the size of the density fluctuations is (i) greater than and (ii) less than one-tenth of the operating wavelength?
- g) Which dispersion mechanism (material or waveguide) is a function of the size of the fiber's core relative to the wavelength of operation?
- h) Modes of a light pulse that enter the fiber at one time exit the fiber at different times. This condition causes the light pulse to spread. What is this condition called?
- i) The mode theory uses electromagnetic wave behavior to describe the propagation of the light along the fiber. What is a set of guided electromagnetic waves called?
- j) Modes that are bound at one wavelength may not exist at longer wavelengths. What is the wavelength at which a mode ceases to be bound called?

Section - B

(4 × 5 = 20)

- Q2)** Define the noise figure of an optical amplifier. Explain the difference between optical and electrical signal-to-noise ratio (SNR)?
- Q3)** a) Determine the bandwidth of an LED source with a rise time equal to 10 ns.
b) Define the noise figure of an optical amplifier. Explain the difference between optical and electrical signal-to-noise ratio (SNR).
- Q4)** Calculate the optical power coupled into the fiber generated by an optic device with a bias current of 20mA and forward voltage of 1.5 V. The device's internal efficiency is 2% and the fiber $\theta = 20^\circ$.
- Q5)** Calculate the distance L_{eff} where a π phase shift occurs for optical power 100 mW in a fibre with effective mode area of $40 \mu\text{m}^2$ at $1.55 \mu\text{m}$. Nonlinear refractive index $n_2 = 2.67 \times 10^{-16} \text{ cm}^2/\text{W}$.
- Q6)** Explain the difference between optical TDM and WDM, using diagrams wherever necessary.

Section - C

(2 × 10 = 20)

- Q7)** a) What are the limitations of FP laser? With help of suitable diagram explain how a DFB laser overcome the limitations imposed by FP. List its significant advantages.
b) List various fiber non-linearities. Explain how they degrade the performance of an optical communication system or Network. What is the permissible BER in case of ordinary optical communications and WDM networks?
- Q8)** a) Explain any one in detail. Describe design, operation and features of the EDFA.
b) Write short note on optical modulators and their applications. What is the impact of chirping on modulator performance?
- Q9)** a) Define the terms material dispersion and waveguide dispersion. What is the mechanism of change of pulse shape introduced by group velocity dispersion in fiber communication system? How does the pulse broadening affect the performance of the system?
b) With schematic diagram explain how the unknown core diameter of fiber is measured.

