



Programme: B.Tech in Electronics & Telecommunication Engineering

Year: IV/Semester VIII (Exam Year: 2024-2025)

Subject: Optical Communication

Date: 01 Aug 2025

Time: 02:00 pm - 05:00 pm (03:00 Hrs.)

Max Marks: 75

RE END SEMESTER EXAMINATION EVEN SEM VIII (2024-2025)

Instructions:

1. This question paper contains 3 pages
2. Answer to each new question to be started on a fresh page.
3. Figure in right hand side indicates full marks
4. Draw neat labelled diagrams wherever necessary.
5. Read the questions carefully
6. All questions are compulsory except for the internal options.
7. Assume necessary data wherever required.

- | | | |
|-------|--|----|
| 1. | | 15 |
| A. | How optical fibers are classified based on material used for fabrication? Explain briefly | 5 |
| B. .. | | 10 |
| I. | Using basic ray optics, explain how light is guided through an optical fiber. Illustrate and define the concept of acceptance angle with the help of a diagram. Further, derive the relationship between the acceptance angle, the numerical aperture, and the refractive indices of the core and cladding of the fiber.
An optical fiber has a numerical aperture of 0.20 and a cladding refractive index of 1.59. Determine:
(a) the acceptance angle for the fiber in water which has a refractive index of 1.33;
(b) the critical angle at the core-cladding interface.
Comment on any assumptions made about the fiber. | 10 |

----- OR -----

II. What is Mode Field Diameter, Cutoff wave length, Modal birefringence and beat length in single mode fibers.

A multimode graded index fiber has an acceptance angle in air of 8° . Estimate the relative refractive index difference between the core axis and the cladding when the refractive index at the core axis is 1.52.

2. 15

A. .. 5

I. Estimate the rms pulse broadening per kilometer for the fiber when the optical source used is an injection laser with a relative spectral width $\sigma\lambda/\lambda$ of 0.0012 at a wavelength of $0.85\text{ }\mu\text{m}$. If The material dispersion is $98.1\text{psnm}^{-1}\text{km}^{-1}$ 5

$$\sigma_m \approx \sigma_\lambda LM$$

----- OR -----

II. What is chromatic dispersion in optical fibers? Explain how it affects signal transmission. 5

B. Define chromatic and intermodal dispersion. How do dispersion-shifted and dispersion-flattened fibers reduce these effects? 10

3. 15

A. The carrier velocity in a silicon p-i-n photodiode with a $25\text{ }\mu\text{m}$ depletion layer width is $3 \times 10^4\text{ m s}^{-1}$. Determine the maximum response time for the device. 5

$$B_m = \frac{v_d}{2\pi W}$$

B. .. 10

I. Discuss bit rate of optical receiver and along with other receiver performance parameters. 10

----- OR -----

II. What is the modulation response concept of LEDs. Also determine the optical output power when the device is modulated with an rms drive current corresponding to the 10

d.c. drive current at frequencies of (a) 20 MHz; (b) 100 MHz. When a constant d.c. drive current is applied to the device the optical output power is 300 μ W. Here The minority carrier recombination lifetime for an LED is 5 ns.

$$P_e = \frac{P_{dc}}{[1 + (\omega\tau_r)^2]^{\frac{1}{2}}}$$

4. 15

A. What is Optical Isolator? Discuss the various phenomenon based on which Optical Isolators can be designed. 10

B. .. 5

I. What is the difference between Optical Connectors and Splicers. 5

----- OR -----

II. How optical power is getting coupled in 2*2 optical coupler? 5

5. 15

A. .. 10

I. A transmitter has an output power of 0.1 mW. It is used with a fibre having NA= 0.25, attenuation of 6 dB/km and length 0.5 km. The link contains two connectors of 2 dB average loss. The receiver has a minimum acceptable power (sensitivity) of -35 dBm. The designer has allowed a 4 dB margin. Calculate the link power budget. 10

----- OR -----

II. What are dispersion and non-linear effects in WDM and DWDM systems? How do they affect the maximum distance and speed each channel can handle? 10

B. Elaborate Fiber Bending loss along with critical radius of curvature R_c in multimode fibers 5