

02 MAY 2023

Reg. No.

Question Paper Code

11830

**B.E./B.Tech. - DEGREE EXAMINATIONS, APRIL/MAY 2023**

Seventh Semester

**Electronics and Communication Engineering**

**EC8751 - OPTICAL COMMUNICATION**

(Regulations 2017)

Duration: 3 Hours

Max. Marks: 100

**PART - A (10 × 2 = 20 Marks)**

Answer ALL Questions

- |   | <i>Marks,<br/>K-Level CO</i> |
|---|------------------------------|
| 1. Consider a parabolic index waveguide with $n_1 = 1.75, n_2 = 1.677$ and core radius 25 micro meter. Calculate the numerical aperture at the axis and at a point 20 micrometer from the axis. | <i>2, K2, CO1</i>            |
| 2. What are the conditions for total internal reflection?   | <i>2, K1, CO1</i>            |
| 3. Define dispersion in optical fibers.   | <i>2, K1, CO2</i>            |
| 4. What is population inversion?  | <i>2, K1, CO3</i>            |
| 5. Why silicon is not used to fabricate LED or Laser diode?   | <i>2, K1, CO3</i>            |
| 6. What is dark current noise?  | <i>2, K1, CO4</i>            |
| 7. Define quantum limit.  | <i>2, K1, CO4</i>            |
| 8. Distinguish between splice and connector.  | <i>2, K2, CO5</i>            |
| 9. List out the features of DWDM.   | <i>2, K1, CO6</i>            |
| 10. What are solutions and give its significance?   | <i>2, K2, CO6</i>            |

**PART - B (5 × 13 = 65 Marks)**

Answer ALL Questions

11. a) Draw the block diagram of the optical fiber communication system and explain briefly about all the components associated with the optical fiber communication system. Write the difference between optical fiber communication system and analog/digital communication system. *13, K2, CO1*
- OR**
- b) (i) A fiber has a core radius of 25mm, core refractive index of 1.48 and relative refractive index difference is 0.01. If the operating wavelength is 0.84mm, find the value of normalized frequency and the number of guided modes. Determine the number of guided modes if  $\Delta$  is reduced to 0.03. *8, K2, CO1*
- (ii) Explore the bound or guided modes in cylindrical optical fibers. *5, K2, CO1*
12. a) Derive an expression for internal quantum efficiency, power and external quantum efficiency of LED. *13, K2, CO3*

*K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create*

**11830**

**OR**

- b) Draw and explain the structure of Fabry Perot resonator cavity for a laser diode. Derive laser diode equation for threshold conditions. *13,K2,CO3*

13. a) Draw the block diagram of fundamental optical receiver. Explain each block. *13,K2,CO4*

**OR**

- b) (i) An InGaAs pin photodiode has the following parameters at a wavelength of 1300nm:  $I_D=4\text{nA}$ ,  $\eta=0.9$ ,  $R_L=1000\Omega$  and the surface current is negligible. The incident power is 300nW and the receiver BW is 20MHz. Find the various noise terms of the receiver.

- (ii) Discuss about avalanche multiplication. *3,K2,CO4*

14. a) Explain the frequency domain measurement method for fiber dispersion measurements with relevant expressions. *13,K2,CO5*

**OR**

- b) Discuss the various fiber alignment losses and joint losses with a neat sketch. *13,K2,CO5*

15. a) Briefly explain the layers of SONET. *13,K2,CO6*

**OR**

- b) Discuss about rise time, optical power required to establish secure link with necessary equation. *13,K2,CO6*

**PART - C (1 × 15 = 15 Marks)**

16. a) (i) The material dispersion in an optical fiber defined by  $250 \text{ psnm}^{-1}\text{Km}^{-1}$ . Estimate the pulse broadening per kilometer due to material dispersion within the fiber when it is illuminated with an LED source with a peak wavelength of 0.9 nm and an RMS spectral width of 45 nm. *8,K2,CO2*

- (ii) What do you mean by pulse broadening? Explain its effect on information carrying capacity of a fiber. *7,K2,CO2*

**OR**

- b) (i) Explain what is meant by the critical bending radius ( $R_c$ ) and critical bending radius ( $R_{cs}$ ) for a multimode and single mode optical fiber respectively with mathematical expression and suitable diagram. *5,K2,CO2*

- (ii) A 6 km optical link consisting of multimode step index fiber has a numerical aperture of 0.2 and a core refractive index of 1.47. Determine. *10,K2,CO2*

- a) Intermodal dispersion or modal delay for the multimode step index fiber.

- b) RMS pulse broadening due to intermodal dispersion.

- c) Maximum bitrate.

- d) Bandwidth length product.