Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 40457

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Seventh Semester

Electronics and Communication Engineering

EC 8751 – OPTICAL COMMUNICATION

(Common for Computer and Communication Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. A step-index fiber has a normalized frequency V = 26.6 at a 1300-nm wavelength. If the core radius is 25 mm, what is the numerical aperture?

2. State leaky modes in optical fiber communication.

3. 150 μW optical power is launched at the input of a 10 km long optical fiber link operating at 850 nm. The output power available is 5 μW. Estimate the total attenuation in dB over the link length neglecting all connector and spice losses. What is the average attenuation per km?

4. Define dispersion. Why intermodal dispersion is not found in single mode fiber?

5. Why silicon is not used for making optical sources?

6. State the mechanisms behind the lasing action.

7. Define quantum limit.

8. Compare cutback technique and insertion loss method.

9. State the concept of WDW technique.

10. Depict EPON architecture and operational concept.

PART B — (5 × 13 = 65 marks)

11. (a) Illustrate the concept of total internal reflection and polarization components of light with necessary expressions. (13)

Or

(b) Write about the Construction, mode field diameter and Propagation Modes of a single mode fiber. (13)

12. (a) Discuss about a non-linear scattering process that is associated with the generation of an acoustic phonon and compare it with a similar process that generates a high frequency optical phonon. (13)

Or

(b) Explain how intersymbol interference affects the bandwidth in optical fiber communication. (13)

13. (a) With neat schematics. Explain about structure of a surface emitting Light Emitting Diode (LED). (13)

Or

(b) Compare and contrast PIN photodetector with Avalanche photo diodes. (13)

14. (a) Write detailed notes on the following:

(i) Various noise sources in the detection mechanism (7)

(ii) Front end amplifier (6)

Or

(b) Write in detail about how tensing schemes are used to improve optical source-to-fiber coupling efficiency. (13)

15. (a) Explain about SONET/SDH transmission formats and speed, SONET/SDH rings and SONET/SDH Networks. (13)

Or

(b) Derive total system rise time for determining the dispersion limitation of an optical fiber link.

PART C — (1 × 15 = 15 marks)

16. (a) Explain the various design techniques for dispersion optimization of single mode fibers. (15)

Or

(b) Justify that soliton is a special kind of wave that can propagate undistorted over song distance and remain unaffected after collision with each other. (15)

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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : X10374

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Seventh Semester
Electronics and Communication Engineering
EC 8751 – OPTICAL COMMUNICATION
(Common to Computer and Communication Engineering)
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Why do we calculate mode field diameter ? Write its significance.
2. What is called as fiber pigtail flylead ?
3. A continuous 12 km long optical fiber link has a loss of 1.5 dB/Km. Propose a proper solution to find the minimum optical power that must be launched into the fiber to maintain the optical power level of 0.3 μw at the receiving end.
4. Consider a single mode fiber having core refractive index $n_1 = 1.5$. The fiber length is 12 meter. Find the time taken by the axial ray to travel along the fiber.
5. Compare and contrast between surface and edge emitting LEDs.
6. The carrier recombination life time for an LED operating at 50 mA DC drive current is 1 nsec. Estimate the values of electrical and optical bandwidth of LED.
7. What are the advantages of a trans-impedance amplifier ?
8. What are the techniques used in splicing ?
9. Consider a spectral band of 0.8 nm (or equivalently, a mean frequency spacing of 100 GHz at a 1550 nm wavelength) within which lasers with narrow linewidths are transmitting. How many of such signal channels fit into the C band ?
10. Define power penalty.

PART – B **(5×13=65 Marks)**

11. a) i) Suppose that an incoming ray from a light source is not within the acceptance angle limits. What will happen to the light to be transmitted ? Suggest a proper solution so that the whole of information to be transmitted is properly sent through the fiber. **(8)**

ii) Step index fiber has an acceptance angle of 18 degrees in air. The fiber has a relative refractive index difference of 2.5%. Estimate the value of the critical angle at the core-cladding interface of the fiber and also the NA of the fiber. **(5)**

(OR)

b) i) Explain about any two fiber fabrication techniques. **(9)**

ii) Calculate the value of critical angle (with respect to the interface) when light travels from glass (n_1 = 1.5) into water (n_2 = 1.33). What is the value of critical angle with respect to the normal drawn on the interface plane at the point of incidence ? **(4)**

12. a) What is birefringence ? Explain how this phenomenon gives rise to PMD in SMF. How would you design a single mode fiber to combat dispersion and attenuation simultaneously at a given operating wavelength ? **(13)**

(OR)

b) What is material dispersion ? How does this parameter affect the bit rate of transmission ? Also derive the mathematical equation for material dispersion. **(13)**

13. a) i) With a schematic of double heterojunction LED explain how carrier confinement and optical confinement can be achieved simultaneously. **(5)**

ii) Define quantum efficiency of an LED. Derive an expression for internal quantum efficiency of an LED and hence discuss the effect of various recombination mechanisms on the quantum efficiency. **(8)**

(OR)

b) Develop the schematics of PIN photodiode and APD and also explain in detail. **(13)**

14. a) Demonstrate the following in detail :

i) Optical Power Measurements **(6)**

ii) Attenuation Measurements. **(7)**

(OR)

b) Explain in detail about various lensing schemes for coupling improvement. **(13)**

15. a) Demonstrate SONET layers and frame structure with diagram. **(13)**

(OR)

b) Explain about Link power budget and rise time budget. **(13)**

PART – C **(1×15=15 Marks)**

16. a) An InGaAsP light source that has a refractive index of 3.540 is coupled to a step index fiber that has a core refractive index of 1.480. Assume that the source size is smaller than the fiber core and that there is a small gap between the source and fiber.

i) If the gap is filled with a gel that has a refractive index of 1.520, what is the power loss in decibels from the source into fiber ? **(10)**

ii) What is the power loss if no gel is used in the small gap ? **(5)**

(OR)

b) i) Derive Laser diode rate equation. **(10)**

ii) A GaAs laser operating at 850 nm has 500 μm length and a refractive index n = 3.7. **(5)**

a) What are its frequency spacing and wavelength spacing ?

b) If at the half power point $\lambda - \lambda_0 = 2$ nm, what is the spectral width of the gain ?

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