Reg. No. :

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B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2019

Seventh Semester

Electronics and Communication Engineering

EC6702 – OPTICAL COMMUNICATION AND NETWORKS

(Regulations 2013)

(Common to : PTEC6702 – Optical Communication and Networks for B.E. (Part-Time) – Sixth Semester – Electronics and Communication Engineering) (Regulations 2014)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Find the value of normalized frequency (V) for a given fiber with $n_1 = 1.455$, $n_2 = 1.448$ and $a = 5\ \mu m$ for wavelength $\lambda_0 = 1550$ nm.

2. Give the spectral bands used for optical fiber communications with its name and designation.

3. A fiber has an attenuation of 0.5 dB/km at 1500 nm. If 0.5 mW of optical power is initially launched into the fiber, estimate the power level after 25 km.

4. A manufacturer's data sheet lists the material dispersion D_{mat} of a GeO_2 doped fiber to be 210 ps/ (nm km) at a wavelength of 860 nm. Find the rms pulse broadening per km due to material dispersion if the optical source is a GaAlAs LED that has as spectral width σ_λ of 40 nm at an output wavelength of 860 nm.

5. A GaAs optical source with a refractive index of 3.6 is coupled to a silica fiber that has a refractive index of 1.48. What is the reflectivity for normal incidence of a plane wave ?

6. What is meant by population inversion ?

7. State the significance of maintaining the fiber outer diameter constant.

8. What is the significance of intrinsic layer in PIN diodes ?

9. Compare the optical link with that of the satellite link.

10. Define power penalty.

(5×13=65 Marks)

PART – B

11. a) Discuss the evolution of fiber optic communication system. (13)

(OR)

b) Describe with the aid of simple ray diagram.
i) The multi mode step index fiber. (5)
ii) The single mode step index fiber. (5)
iii) Compare the advantages and disadvantages of these two types of fiber for their use as an optical channel. (3)

12. a) Discuss about the absorption losses in optical fibers and compare and contrast the intrinsic and extrinsic absorption mechanisms. (13)

(OR)

b) Suggest and validate the techniques employed and the fiber structures utilized to provide
i) Dispersion shifted single mode fibers. (5)
ii) Dispersion flattened single mode fibers (4)
iii) Non zero dispersion shifted single mode fibers. (4)

13. a) i) Describe the various types of fiber connectors. (5)
ii) Describe various fiber splicing techniques with their diagrams. (8)

(OR)

b) i) Draw and explain the different structures used to achieve carrier and optical confinement in laser diodes. (8)
ii) Explain the lensing schemes used to improve optical source-to-fiber coupling efficiency. (5)

14. a) Discuss with necessary expressions that different types of noises that affect the performance of a photo detector. (13)

(OR)

b) i) Explain the technique used in frequency – Domain intermodal dispersion measurement. (7)
ii) Explain the Insertion – Loss method that is used for attenuation measurement. (6)

15. a) i) Analyse the rise time budget for a fiber link. (8)
ii) Assume that the LED together with drive circuit has a rise time of 15 ns. LED has spectral width of 40 nm. We have a material dispersion related rise time degradation of 21 ns over the 6 km link. The rise time degradation from the receiver is 14 ns. The modal dispersion induced fiber rise time is 3.9 ns. Calculate link rise time. (5)

(OR)

b) i) With suitable example, explain the conditions and constrains in the formulation and finding solution for routing and wavelength assignment problems in an optimal way. (8)

ii) A transmitter has an output power of 0.1 mW. It is used with a fiber 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. (5)

PART – C (1×15=15 Marks)

16. a) i) Briefly indicate with the aid of suitable diagrams the difference between meridional and skew ray paths in step index fibers. Derive an expression for the acceptance angle for a skew ray which changes direction by an angle 2γ at each reflection in a step index fiber in term of the fiber NA and γ. It may be assumed that ray theory holds for the fiber. (10)

ii) A step index fiber with a suitably large core diameter for ray theory considerations has core and cladding refractive indices of 1.44 and 1.42 respectively. Calculate the acceptance angle in air for skew rays which change direction by 150° at each reflection. (5)

(OR)

b) Describe with the aid of suitable diagrams the mechanism giving the emission of light from a LED. Discuss the effects of this mechanism on the properties of the LED in relation to its use as an optical source for communication. (15)

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