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Question Paper Code : 90486

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

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. Depict a practical optical communication system.

2. Suppose we have a 50 μm diameter graded-index fiber with a parabolic refractive index profile (α=2). If the fiber has a numerical aperture NA = 0.22, what is the total number of guided modes at a wavelength of 1310 nm?

3. Plot attenuation versus wavelength for a typical glass fiber showing major attenuation windows.

4. A 62.5/125 mm step index fiber has a core and cladding refractive index values of 1.50 and 1.48, respectively, at a wavelength of operation of 1330 nm. Estimate the value of the critical radius of curvature from the viewpoint of macro-bending loss.

5. Compare Light Emitting Diode (LED) and Laser Diode (LD) light source.

6. List out the required characteristics of the photodetector used for optical fiber communication.

7. An engineer wants to find the attenuation at 1310 nm of a 4.95-km long fiber. The only available instrument is a photodetector which gives an output reading in volts. Using this device in a cutback attenuation setup, the engineer measures an output of 6.58 V from the photodiode at the far end of the fiber. After cutting the fiber 2 m from the source, the output voltage from the photodetector now reads 2.21V. What is the attenuation of the fiber in dB/km?

8. What are various noise sources and disturbances in an optical pulse detection mechanism?

9. Draw the basic EPON architecture and operational concept.

10. An engineer wants to create a link consisting of 40 m of OM2 fiber that has a 500-MHz Bandwidth and 100 m of OM3 fiber that has a 2000-MHz bandwidth. What is the effective maximum link length?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Depict the basic concept of total internal reflection and critical angle relevant to optical fiber. (5)

(ii) Elaborate on the formation of modes in a planar waveguide structure. (8)

Or

(b) (i) Write a short note on a method that was developed by Izawa et al. for continuous production of low-loss fiber in a controlled environment. (6)

(ii) Brief about the mode field diameter and propagation modes of a single mode fiber. (7)

12. (a) Explain about various scattering losses that occur when light propagates through the fiber. (13)

Or

(b) With necessary expressions, write a short note on

(i) Material dispersion (7)

(ii) Polarization mode dispersion. (6)

13. (a) Illustrate a typical GaAs/AlGaAs double-heterostructure injection laser diode and give the expression for optical confined factor and normalized waveguide thickness. (13)

Or

(b) Illustrate the operating principle of PIN photodetector and derive the expression for its Noise equivalent power. (13)

14. (a) Derive the expression for error probability (P_e), if the probabilities of 0 and 1 pulses are equally likely at the optical receiver. (13)

Or

(b) Describe the various splicing techniques used to create a permanent or semi-permanent joint between two fibers. (13)

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

Or

(b) Write about the soliton parameters and derive the expression for soliton width and spacing. (13)

PART C — (1 × 15 = 15 marks)

16. (a) An STM-1 ring is spliced every 2 km (spice loss: 0.3 dB per splice) and the modal-dispersion-induced fiber rise time is 2 ns. For the parameters given below, what is the longest link possible for a single mode fiber? And state whether the fiber rise time resulting from GVD limits the link length.

Transmitter	Receiver
Wavelength : 1310 nm	Receiver sensitivity : 32 dB
Output Power : –15 dBm	Rise time : 1 ns
Rise time : 1.3 ns	Loss : 0.35 dB/km for 1310 nm
Spectral width : 5 nm	Connector loss : 1dB
Connector loss : 1 dB	

Or

(b) The rise time of the transmitter and receiver is specified as 0.25 ns and 0.35 ns, respectively. Consider the following parameters: modal-dispersion-induced fiber rise time is 3.9 ns^2, dispersion is 2 ps/km-nm, the spectral width of the source is 3 nm, and link length is 50 km. State whether 1 Gbps is feasible for OOK-NRZ and OOK-RZ modulation formats in a single mode fiber.

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