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10EC/TE72

Seventh Semester B.E. Degree Examination, Aug./Sept.2020
Optical Fiber Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Bring out the advantages of optical fibers as compared to copper cables. **(06 Marks)**

b. Distinguish between Step Index and Graded Index fibers in terms of RI profile and the total number of guided modes 'M' that can be accommodated in these fibers. **(07 Marks)**

c. Light travelling in air strikes a glass plate on an angle $\phi_1 = 33°$, where ϕ is the angle between incident ray and glass surface. On striking the glass part of the beam is reflected and part is refracted. If these reflected and refracted beams make an angle of 90° with each other, what is the refractive index of glass? What is the critical angle for the glass? **(07 Marks)**

2 a. Derive an expression for pulse spread due to material dispersion using group delay concept. **(07 Marks)**

b. Explain the design optimization of Single model fibers with respect to Refractive Index profile.
(i) 1300 mm optimized fiber (ii) Dispersion shifted fiber (iii) Dispersion flattened fiber. **(07 Marks)**

c. A 6 km long optical link consists of multimode step index fiber with core refractive index of 1.5 and relative refractive index difference of 1%. Estimate
(i) delay difference between the slowest and fastest modes at fiber output.
(ii) rms pulse broadening due to intermodal dispersion on the link.
(iii) Max. bit rate that may be obtained without substantial errors on link assuming only intermodal dispersion.
(iv) BW-length product corresponding to (iii). **(06 Marks)**

3 a. Is gain a function of frequency in a laser. Substantiate your answer with necessary proof. List atleast 2 advantages and disadvantages of lasers. **(07 Marks)**

b. A given silicon APD has a quantum η of 65% at a wavelength of 900 nm. If 0.5 μW of optical power produces a multiplied photocurrent of 10 μA, calculate multiplication factor M. **(03 Marks)**

c. With neat figure, explain the operation of APD and hence explain the terms detector responsibility and quantum efficiency. **(10 Marks)**

4 a. Show that the optical power coupled into a step index fiber is given by

$$P = \left(\frac{a}{r_s}\right)^2 P_s (NA)^2 \quad \text{for } r_s > a,$$ where the symbols have their usual meaning. **(08 Marks)**

b. Write a note on the different mechanical misalignments that could be encountered during fiber splicing with figures. **(04 Marks)**

c. A 4 port multimode fiber FBT coupler has 50 μW optical power launched into port 1. Measured outputs at ports 2, 3 and 4 are 0.004, 26.0 and 27.5 μW respectively. [Port 1 4 = Input and output of 1 fiber, Port 2 and 3 are input and output of another fiber] Calculate insertion loss and cross talk. **(04 Marks)**

d. Listing the requirements of good connectors used in OFC, explain the butt joint connector with a neat figure. **(04 Marks)**

PART – B

5 a. Explain the various error sources in an optical pulse detection mechanism. **(06 Marks)**

b. Explain the diagram fundamental concepts of coherent detection mechanism. **(06 Marks)**

c. Which are the different key performance parameters that can be used for assessing the data handling ability of a digital transmission system? Explain with respect to the eye diagram. **(08 Marks)**

6 a. Derive an expression for the CNR of an analog optical communication system under the limiting condition of noise sources involved. **(10 Marks)**

b. An optical fiber system is to be designed to operate over an 8 km length without repeaters. The rise time of the components are
Source (LED) : 8 ns ; Fiber (internodal) : 5 ns/km ;
Pulse broadening (intra modal) : 1 ns/km ; Detector (PIN) : 6 ns
Estimate the maximum bit rate that must be achieved on the link when using a NRZ format. **(05 Marks)**

c. What is frequency chirping? Bring out any one application of this concept as applied to optical communication system. **(05 Marks)**

7 a. Explain operational principles of WDM. Give example of WDM component. **(08 Marks)**

b. Describe (i) SONET/SDH rings
(ii) SONET/SDH Networks
(iii) Frame format of SONET/SDH. **(12 Marks)**

8 Write short notes on any 4 :

a. Burst Mode Receivers

b. Sub Carrier Multiplexing

c. Mach Zender Interferometer

d. EDFA

e. Network Topologies used in Optical Networks. **(20 Marks)**

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