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10EC/TE72

Seventh Semester B.E. Degree Examination, July/August 2022

Optical Fiber Communication

Time: 3 hrs. Max. Marks:100

Note:* 1. *Answer any FIVE full questions, selecting at least TWO questions from each part.
2. Missing data may be suitably assumed.

PART – A

1 a. Summarize the inherent advantages of optical fiber over conventional copper cables. **(06 Marks)**

b. Describe with neat diagram different types of optical fiber waveguides. Using ray theory, explain the propagation of light inside the fiber. **(08 Marks)**

c. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.5. A light ray is incidented at the core-cladding interface with a critical angle of 78.5°. Estimate:
i) Refractive index of cladding
ii) Numerical aperture
iii) The acceptance angle in air for the fiber **(06 Marks)**

2 a. Explain the following parameters:
i) Absorption ii) Group delay iii) Scattering loss
iv) Chromatic dispersion v) Bending loss. **(10 Marks)**

b. The mean optical power launched into an optical fiber link is 1.8mw and the fiber attenuation is 1.8dB. Determine the maximum possible link length without repeaters when the minimum optical power level required at detector is 4μw. Calculate the power received in dBm after 10km. **(04 Marks)**

c. Describe and explain signal distortion in optical fibers. **(06 Marks)**

3 a. Draw the cross section of GaALAS double hetero structure LED energy band diagram and refractive index variation. Explain their importance. **(10 Marks)**

b. Derive an expression for lasing condition and hence for optical gain in LASERS. **(10 Marks)**

4 a. With the aid of simple sketches, outline optical fiber coupler types and their functions. **(08 Marks)**

b. Discuss different types of fiber misalignment and the factors which causes the losses due to those misalignment. **(06 Marks)**

c. A single mode fiber has the following parameters:
Normalised frequency (V) = 2.40
Core refractive index (n_1) = 1.46
Core diameter (2a) = 8μm
Numerical aperture (NA) = 0.1
Normalised spot size (ω) = 3.12 μm.
Estimate the total insertion loss of a fiber joint with a lateral misalignment (Y) of 1 μm and an angular misalignment (θ) of 1°. **(06 Marks)**

PART – B

5 a. With neat sketches, explain the power full measurement tools for accessing the data handling ability of a digital transmission system. **(08 Marks)**

b. Explain the various noise and disturbance associated with the signal detection system. **(06 Marks)**

c. Write a note on analog receiver. **(06 Marks)**

6 a. Explain with block diagram, the elements of analog link. List the signal impairments in analog systems. **(06 Marks)**

b. Explain sub-carrier multiplexing techniques in optical fiber communication. **(04 Marks)**

c. Briefly explain the rise time budget analysis with its basic elements contribute to system risetime. **(10 Marks)**

7 a. Describe the operational principles of WDM, depicting the implementation of a typical WDM network containing various types of optical amplifier. **(08 Marks)**

b. With a neat diagram, explain the working principle of Mach-Zehnder inter-ferometer multiplexer. **(08 Marks)**

c. The input wavelengths of a 2×2 silicon Mach-Zehnder inter ferometer are separated by 10 GHz. The effective refractive index in the waveguide is 1.5. Calculate waveguide length difference. **(04 Marks)**

8 a. Explain the possible applications of optical amplifier. **(04 Marks)**

b. With neat sketches, explain the simplifier energy level and various transition process of Er^{3t} in silica. **(06 Marks)**

c. Explain the basic formats of STS N sonnet frame and STM-N-SDH frame. **(05 Marks)**

d. Write a note on high speed light wave links. **(05 Marks)**

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