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06EC72

Seventh Semester B.E. Degree Examination, Dec.2013/Jan.2014

Optical Fiber Communication

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Distinguish between:
i) Single mode versus multimode fibers
ii) Step index and graded index fibers. **(08 Marks)**

b. Derive the expressions for numerical aperture of a step index fiber in terms of acceptance angle, cone and cladding refracting indices and further in terms of the refractive index difference, with the help of a ray diagram. **(06 Marks)**

c. A step index fiber with core and cladding refractive indices of 1.44 and 1.42 respectively. Calculate acceptance angle for skew rays which change direction by 150^0 at each reflection. **(06 Marks)**

2 a. Explain the material absorption losses by sketching the various loss mechanisms at different wavelengths. **(06 Marks)**

b. What is material dispersion? Starting from the expression for group delay, derive the expression for material dispersion. **(08 Marks)**

c. What is critical radius of curvature for a fiber? A multimode graded index fiber has a refractive index at core axis of 1.46 with a cladding refractive index of 1.45. The critical radius of curvature occur at 84 μm when the fiber is transmitting light of a particular wavelength. Determine the wavelength of transmitted light. **(06 Marks)**

3 a. Draw and explain the cross section of the Ga-Aℓ-As double hetero structure LED, energy band diagram and refractive index profile and explain. **(10 Marks)**

b. Derive the laser diode rate equation. **(06 Marks)**

c. Photons of energy are incident on a photo diode which has a responsivity of 0.75 A/W. If the optical power is 15 μW, what is the photocurrent generated? If the wavelength of light is 1300 nm, find the quantum efficiency.
$h = 6.625 \times 10^{-34}$ JS $\quad q = 1.6 \times 10^{-19}$ C **(04 Marks)**

4 a. Explain the different mechanical splicing techniques. **(06 Marks)**

b. Name the requirements of a good connector design. Explain the different types of optical fiber connections used. **(08 Marks)**

c. An LED has a circular area of radius 35 μm and a Lambertian emission pattern with 150 W/(cm^2.sr) axial radiance at a given drive current. Compare the optical powers coupled into two step index fibers, one of which has a Core radius of 25 μm with NA = 0.20 and the other has a Core radius of 50 μm with NA = 0.20. **(06 Marks)**

PART – B

5 a. Explain the two types of front end amplifiers used in optical fiber receivers with associated diagrams. **(06 Marks)**

b. Explain Burst mode receivers. **(06 Marks)**

c. Explain fundamental concept of a coherent light wave system using coherent detection technique with the help of figure and expressions. **(08 Marks)**

6 a. Find the maximum transmission distance for an optical digital link with the following parameters:
Operating at 850 nm
Optical power launched is 0 dBm
Fiber attenuation is 3.5 dB/km
Connector loss is 1 dB/connector
APD sensitivity is –50 dBm
Assume system margin = 6 dBm. **(04 Marks)**

b. Explain the multi-channel AM modulation technique with the help of block diagram and relevant expression. **(06 Marks)**

c. Write short notes on: i) Chirping, ii) Radio over fiber link. **(10 Marks)**

7 a. Explain the operational principles of WDM with relevant diagram. **(06 Marks)**

b. Explain the design and operation of a polarization independent isolator. **(06 Marks)**

c. What are tunable optical filters? Explain how the wavelength can be adjusted in a tunable filter. **(08 Marks)**

8 a. Explain the amplification mechanism of an EOFA amplifier with the help of energy band diagrams. **(08 Marks)**

b. Explain the basic structure of STS-1 Sonet frame. **(06 Marks)**

c. Explain the architecture of ROADM based on the use of wavelength blocker with relevant diagram. **(06 Marks)**

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