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BIEL-017

B.Tech. – VIEP – ELECTRONICS AND COMMUNICATION ENGINEERING (BTECVI)

00456

Term-End Examination

June, 2016

BIEL-017 : OPTICAL FIBER COMMUNICATION

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **seven** questions. All questions carry equal marks. Assume missing data, if any. Use of scientific calculator is permitted.*

1. (a) List the advantages of optical fiber communication over digital communication. Explain. 5

(b) A step index fiber in air has a numerical aperture of 0·16, a core refractive index of 1·45 and a core diameter of 60 μm. Determine the normalized frequency for the fiber when light at a wavelength of 0·9 μm is transmitted. Estimate the number of guided modes propagating in the fiber. 5

2. Using simple ray theory, describe the mechanism for the transmission of light within an optical fiber. Show how this is related to the fiber numerical aperture and the refractive indices for the fiber core and cladding. *10*

3. Briefly explain the reasons for pulse broadening due to material dispersion in optical fibers. Derive an expression for the RMS pulse broadening due to material dispersion in an optical fiber and define the material dispersion parameter. *10*

4. (a) An 11 km optical fiber link consisting of optimum near-parabolic profile graded index fiber exhibits rms intermodal pulse broadening of 346 ps. If relative refractive index difference is 1·5%, estimate core axis refractive index and numerical aperture. *5*

   (b) Briefly describe linear scattering losses in optical fiber with regard to MIE scattering loss. *5*

5. (a) Briefly outline the general requirements for a source in optical fiber communication. *5*

   (b) The lattice constant of a heterojunction semiconductor laser grows with a layer of GaAsP (active region is 0·56 nm). The lasing takes place from the bottom of the conduction band. Given the band gap energy is 1·85 eV. Calculate the longest wavelength of operation of this laser. *5*

6. Outline the common LED structures for optical fiber communications discussing their relative merits and drawbacks. In particular, compare surface and edge emitting devices. Comment on the distinction between multimode and single mode devices. *4+3+3=10*

7. (a) In a GaAs semiconductor laser diode of length L = 500 μm, the reflectivities $R_1 = R_2 = 0{\cdot}32$. The effective absorption coefficient of the material in the optical path is equal to 10 cm^{-1}. Calculate the optical gain. *5*

   (b) Briefly outline the advantages and drawbacks of the LED in comparison with the injection laser. *5*

8. Explain the detection process in the p-n photodiode. Compare this device with the p-i-n photodiode. *5+5=10*

9. Define the quantum efficiency and the responsivity of a photodetector. Derive an expression for the responsivity of an intrinsic photodetector in terms of the quantum efficiency of the device and the wavelength of the incident radiation. *10*

10. Write short notes on any ***two*** of the following : *2×5=10*

(a) Regenerative Repeater

(b) Heterojunction and DH structure

(c) Fiber Bend Losses
