AU – 2674 Add

Fifth Semester B. E. (Electronics Engineering) (CGS) Examination

FIBRE OPTICS

Paper – 5 FEXN 05

(USC – 10667)

P. Pages : 3

Time : Three Hours] [Max. Marks : 80

Note : (1) Separate answer book must be used for each section in the subject Geology, Engineering material of civil branch and Separate answer book must be used for Section A and B in Pharmacy and Cosmetic Tech.
(2) Answer **Three** questions from Section A and **Three** questions from Section B.
(3) Assume suitable data wherever necessary.
(4) Retain the construction lines.
(5) Illustrate your answer wherever necessary with the help of neat sketches.

SECTION A

1. (a) Describe single mode step index fiber and list its advantages and disadvantages over multimode step index fiber. 7

   (b) Critical angle at the core–cladding interface is 65^0 and the velocity of light in the core of a step index fiber is 2.13×10^8 ms^{-1}. Determine the numerical aperture and the acceptance angle for the fiber in air. 6

OR

2. (a) What is meant by numerical aperture for an optical fiber ? Show how this is related to the acceptance angle of fiber and the refractive indices for the fiber core and cladding. 7

   (b) Define the normalized frequency for an optical fiber.

   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 Further, estimate the number of guided modes propagating in the fiber. 6

3. (a) Explain absorption losses and bending losses in fiber. 8

(b) The numerical input/output mean optical power ratio in a 1 km, length of optical fiber is found to be 2.5. Calculate the received mean optical power when a mean optical power of 1 mW is launched into a 5 km length of the fiber (assuming no joints or connectors). 5

OR

4. (a) Explain material dispersion and waveguide dispersion in optical fiber. 7

(b) A 6 km optical link consists of multimode step index fiber with a core refractive index of 1.5 and a relative refractive index difference of 1%.

Estimate :

(i) The delay difference between the slowest and fastest modes at the fiber output.

(ii) The rms pulse broadening due to intermodal dispersion on the link ;

(iii) The maximum bit rate that may be obtained without substantial errors on the link assuming only intermodal dispersion. 6

5. (a) What are the general requirements for a source in optical fiber communication. 7

(b) Describe the construction and working of double heterojunction LED and list its advantages. 7

OR

6. (a) Explain following :—

(i) Spontaneous Emission.

(ii) Stimulated emission.

(iii) Carrier life time. 7

(b) The radiative and nonradiative recombination lifetimes of the minority carriers in the active region of a double-heterojunction LED are 60 ns and 100 ns respectively. Determine the total carrier recombination lifetime and the power internally generated within the device when the peak emission wavelength is 0.87 μm at drive current of 40 mA. 7

SECTION B

7. (a) Explain the detection process in the p–n photodiode. Compare this device with the PIN photodiode. 7

(b) A p–n photodiode has a quantum efficiency of 50% at a wavelength of 0.9 μm. Calculate :

(a) Its responsivity at 0.9 μm;

(b) The received optical power if the mean photocurrent is 10^{-6}A.

(c) The corresponding number of received photons at this wavelength. 6

OR

8. (a) 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. 7

(b) Explain what is meant by the long–wavelength cut-off point for photodetector. Derive a relevant expressions for it. 6

9. (a) Explain mechanical splicing in optical fiber. 8

(b) Explain Expanded beam connector for optical fiber. 5

OR

10. (a) Explain the geometrical and optical parameters of the two optical fibers which are jointed will affect the optical attenuation. 7

(b) With the help of diagram explain Fusion splicing and list its advantages. 6

11. (a) Explain fiber absorption loss measurement. 7

(b) Explain cut–off wavelength measurement in fiber. 7

OR

12. (a) Explain dispersion measurement technique in the time domain. 7

(b) Explain any one method for numerical aperture measurement. 7