Registration No. :

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B. Tech

PEEC 4302

Fifth Semester Back Examination – 2014
FIBER OPTICS AND OPTOELECTRONICS DEVICES
BRANCH (S) : MM, MME
QUESTION CODE : L 299

Full Marks – 70

Time : 3 Hours

*Answer Question No. 1 which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.

1. Answer the following questions :   2 ×10

    (a) What is waveguide dispersion in an optical fiber ?

    (b) Write briefly the application of a circulator.

    (c) Draw the refractive index profile for a step index optical fiber.

    (d) Discuss briefly the quantum efficiency.

    (e) Differentiate between an avalanche photodiode and a pin photodiode.

    (f) Explain splicing in a single-mode fiber.

    (g) Briefly describe the axial misalignment.

    (h) Write briefly about pulse broadening in a graded index fiber.

    (i) Define shot noise in a photodiode.

    (j) What is mode field diameter ?

2. Derive an expression to estimate the total average cladding power in a step index fiber under the assumption that the light source is an incoherent source and excites every fiber mode with the same amount of power.   10

3. The relative refractive index difference between the core axis and the cladding of a graded index fiber is 0.7% when the refractive index at the core axis is 1.45. Estimate the values for the numerical aperture of the fiber when: 10

    (a) The index profile is not taken into account; and

    (b) The index profile is assumed to be triangular.

    Give comments on the results.

P.T.O.

4. (a) A multimode graded index fiber exhibits total pulse broadening of 0.1 micro second over a distance of 15 km. Estimate 5

  (i) The maximum possible bandwidth on the link assuming no intersymbol interference.

  (ii) The pulse dispersion per unit length.

  (b) Briefly describe the major reasons for the cabling of optical fibers which are to be placed in a field environment. Thus state the functions of the optical fiber cable. 5

5. (a) Describe the three types of fiber misalignment which may contribute to insertion loss at an optical fiber joint. 5

  (b) A single mode step index fiber has a critical bending radius of 2 mm when illuminated with light at a wavelength of 1.30 μm. Calculate the relative refractive index difference for the fiber. 5

6. (a) When 3×10^{11} photons each with a wavelength of 0.85 μm are incident on a photodiode, on average 1.2×10^{11} electrons are collected at the terminals of the device. Determine the quantum efficiency and the responsivity of the photodiode at 0.85 μm. 5

  (b) Two polarisation maintaining fibers operating at a wavelength of 1.3 μm have beat lengths of 0.7 mm and 80 m. Determine the modal birefringence in each case and comment on the results. 5

7. (a) Calculate the ratio of the stimulated emission rate to the spontaneous emission rate for an incandescent lamp operating at a temperature of 1000k. It may be assumed that the average operating wavelength is 0.5 μm. 5

  (b) What is population inversion ? Explain the difference between a LED and Laser. 5

8. Answer any **two** of the following : 5×2

  (a) Scattering losses in optical fiber.

  (b) Explain briefly the modal birefringence.

  (c) Describe briefly a p-n photodiode showing depletion and diffusion regions.

  (d) Shot noise in a photo detector.