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SIXTH SEMESTER B.Tech. [EP]

MID SEM EXAMINATION (*March 2019*)

EP- 302 FIBER OPTICS AND OPTICAL COMMUNICATION

Time: 1:30 Hours *Max. Marks: 30*

Note: Answer all questions.
All symbols have their usual meanings
Assume suitable missing data, if any.

1. (a) Consider a step index fiber with $n_1 = 1.5$, $\Delta = 0.015$ and a $= 25\mu m$ placed in water of refractive index 1.33. Calculate n_2, numerical aperture and the maximum acceptance angle.

   (b) Illustrate the following conditions in an optical fiber
   (i) Angle of incidence is less than the critical angle of incidence
   (ii) Angle of incidence is equal to the critical angle of incidence
   (iii) Angle of incidence is greater than the critical angle of incidence

   (c) Enumerate the limitations of ray theory of light guidance.

   (d) A single mode step index fiber has a core diameter of $7\mu m$ and a core refractive index of 1.49. Estimate the shortest wavelength of light which allows the single mode operation when the relative refractive index difference for the fiber is 1%.

   (e) A multimode step index fiber has a relative refractive index difference of 1% and a core refractive index of 1.5. The number of modes propagating at a wavelength

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of 1.3 μm is 1100. Estimate the diameter of the fiber core.

(f) The power of a 2mW laser beam decreases to 15μW after traversing through 25km of single mode optical fiber. Calculate the attenuation of the fiber.

(g) Consider an LED operating at 1.3μm with a spectral width of 20 nm.

At this wavelength $\frac{d^2n}{d\lambda_o^2} \approx -0.00055\,\mu m^{-2}$. Calculate the material dispersion.

[2*7=14]

2. Discuss any two methods of fiber fabrication.

[4]

3. Obtain the solution of the one dimensional wave equation

[4]

4. For pure silica the refractive index variation in the wavelength domain $0.5\mu m < \lambda_0 < 1.6\mu m$ can be assumed to be given by the following empirical formula

$$n(\lambda_0) \approx C_o - a\lambda_o^2 + \frac{b}{\lambda_o^2}$$

Where $C_o \approx 1.451, a \approx 0.003\,\mu m^{-2}, b \approx 0.003\,\mu m^2$ and λ_0 is measured in μm. Calculate the group velocity at $\lambda_0 = 0.80$ μm and at $\lambda_0 = 0.85$ μm. Further, obtain at what value of λ_0, group velocity attains a maximum value.

[4]

5. Obtain the expression for the total broadening of a light pulse due to intermodal dispersion in a multimode step index fiber. Further, calculate the pulse broadening per unit length of the fiber having core diameter = 100μm, core refractive index = 1.5 and cladding refractive index = 1.48. [4]