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Total No. of Pages: One
SEMESTER: 7TH
Roll No.:_____

B. Tech: ECE
(FEB-2019)

END SEMESTER EXAMINATION

Supplementary Exam

Subject: OPTICAL COMMUNICATION

Paper Code: EC-407

Time: 3:00 Hours

Max. Marks: 40

Note: Answer any *TEN* questions. All questions carry equal marks.

Assume suitable missing data, if any.

1. A typical relative refractive index difference for an optical fiber designed for long distance transmission is 1%. Estimate the *NA* and the solid acceptance angle in air for the fiber when the core index is 1.46. Further, calculate the critical angle at the core–cladding interface within the fiber. It may be assumed that the concepts of geometric optics hold for the fiber.
2. An optical fiber in air has an *NA* of 0.4. Compare the acceptance angle for meridional rays with that for skew rays which change direction by 100° at each reflection.
3. A graded index fiber has a core with a parabolic refractive index profile which has a diameter of 60 μm. The fiber has a numerical aperture of 0.2. Estimate the total number of guided modes propagating in the fiber when it is operating at a wavelength of 1.25 μm.
4. Estimate the maximum core diameter for an optical fiber with the relative refractive index difference (1.5%) and core refractive index (1.48) in order that it may be suitable for single-mode operation. It may be assumed that the fiber is operating at the same wavelength (0.85 μm). Further, estimate the new maximum core diameter for single-mode operation when the relative refractive index difference is reduced by a factor of 10.
5. Explain the concept of electromagnetic modes in relation to a planar optical waveguide. Discuss the modifications that may be made to electromagnetic mode theory in a planar waveguide in order to describe optical propagation in a cylindrical fiber.
6. Discuss absorption losses in optical fibers, comparing and contrasting the intrinsic and extrinsic absorption mechanisms.
7. Briefly describe linear scattering losses in optical fibers with regard to:
   (a) Rayleigh scattering;
   (b) Mie scattering.
   The photo elastic coefficient and the refractive index for silica are 0.286 and 1.46 respectively. Silica has an isothermal compressibility of 7×10^{-11} $m^2 N^{-1}$ and an estimated fictive temperature of 1400 K. Determine the theoretical attenuation in decibels per kilometre due to the fundamental Rayleigh scattering in silica at optical wavelengths of 0.85 and 1.55 μm. Boltzmann's constant is 1.381×10^{-23} J K^{-1}.
8. Explain the amplification mechanism in Erbium Doped Fiber Amplifier [EDFA] and discuss EDFA architecture.
9. Describe the two distinctive features of an optical soliton pulse and indicate how loss-managed solitons are produced and maintained on an actual single-mode fiber link.
10. Briefly describe the major reasons for the cabling of optical fibers which are to be placed in a field environment. State the functions of the optical fiber cable.
11. An optical fiber has a core refractive index of 1.5. Two lengths of the fiber with smooth and perpendicular (to the core axes) end faces are butted together. Assuming the fiber axes are perfectly aligned, calculate the optical loss in decibels at the joint (due to Fresnel reflection) when there is a small air gap between the fiber end faces.
12. A step index fiber has a core refractive index of 1.5 and a core diameter of 50 μm. The fiber is jointed with a lateral misalignment between the core axes of 5 μm. Estimate the insertion loss at the joint due to the lateral misalignment assuming a uniform distribution of power between all guided modes when:
    (a) there is a small air gap at the joint;
    (b) the joint is considered index matched.