<u>Numerical Problems for practice in Unit 1</u>

1. A silica optical fiber with a core refractive index of 1.50 and cladding refractive index of 1.47. Determine (a) Critical angle (b) Numerical Aperture and (c) Acceptance angle.
2. Let medium 1 be glass and medium 2 be water for an angle of incidence of 30°. Determine the angle of refraction.
3. A multimode graded index fiber has an acceptance angle in air 8°. Estimate the relative refractive index difference between the core axis and cladding when the refractive index at the core axis is 1.52.
4. A typical refractive index difference for an optical fiber designed for long distance transmission is 1%. Determine the Numerical Aperture when the core index is 1.46. Calculate the critical angle at the core-cladding interface with in the fiber.
5. A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5% is operating at a wavelength of 0.85 μm. If the core refractive index is 1.48. Estimate (a) Normalized frequency (b) No.of. Guided modes.
6. A graded index fiber has a core with a parabolic refractive index profile, which has a diameter of 50 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 μm.
7. A step index fiber has a normalized frequency V = 26.6 at a 1300 nm wavelength. If the core radius is 25 μm. Find out Numerical Aperture.
8. Determine the cut off wavelength for a step index fiber to exhibit single-mode operation. When the core refractive index and radius are 1.46 and 4.5 μm with the relative refractive index difference being 0.25 %.
9. A typical refractive index difference for an optical fiber designed for long distance transmission is 1%. Determine Numerical Aperture. Core index is 1.46. Calculate critical angle at the core-cladding interface with in the fiber.
10. A low loss fiber has average loss of 3 dB/km at 900 nm. Compute the length over which – a) Power decreases by 50 % b) Power decreases by 75 %.

11. For a 30 km long fiber attenuation 0.8 dB/km at 1300 nm. If a 200 μW power is launched into the fiber, find the output power.

12. When mean optical power launched into an 8 km length of fiber is 12 μW, the mean optical power at the fiber output is 3 μW.

    Determine

    l) Overall Signal attenuation in dB.

    2) The overall signal attenuation for a 10 km Optical link using the same fiber with splices at 1 km intervals, each giving an attenuation of 1 dB.

13. A continuous 12 km long optical fiber link has a loss of 1.5 dB/km.

    i) What is the minimum optical power level that must be launched into the fiber to maintain as optical power level of 0.3 μW at the receiving end?

    ii) What is the required input power if the fiber has a loss of 2.5 dB/km?

14. Optical power launched into fiber at transmitter end is 150 μW. The power at the end of 10 km length of the link working in first window is -38.2 dBm. Another system of same length working in second window is 47.5 μW. Same length system working in third window has 50 % of launched power. Calculate fiber attenuation for each case and mention wavelength of operation.

15. The input power to an optical fiber is 2 mW while the power measured at the output end is 2 μW. If the fiber attenuation is 0.5 dB/km, calculate the length of the fiber.

16. An LED operating at 850 nm has a spectral width of 45 nm. What is the pulse spreading in ns/km due to material dispersion?

17. What is the pulse spreading when a laser diode having a 2 nm spectral width is used? Find the material dispersion induced pulse spreading at 1550 nm for an LED with a 75 nm spectral width.

18. For a single mode fiber n_2=1.48 and Δ=0.2% operating at λ=1320 nm, compute the waveguide dispersion if $V.\ d^2(V_b)/d\gamma^2=0.26$.