HOME ASSIGNMENT (PHIC101)

UNIT III —OPTICAL FIBER

1. Explain the principle of total internal reflection and how it is used in optical fibers to guide light.

2. Describe the structure of a typical optical fiber, including the core, cladding, and coating (Protecting jacket).

3. What is numerical aperture (NA) in an optical fiber, and why is it important?

4. Tabulate the differences between single mode and multimode optical fiber.

5. Explain the construction and light propagation in step-index and graded –index optical fiber. Tabulate advantages and disadvantages of step-index and graded –index optical fiber.

6. For a step index fiber, the core and cladding refractive indices are 1.54 and 1.5 respectively. Calculate following if the fiber is placed in the water (i) Critical angle, (ii) Fractional refractive index, (iii) Numerical aperture, and (iv) Acceptance angle in the water.

7. A step index fiber has a core refractive index 1.425. The Acceptance angle in air is 8.50°. If the fiber is kept in water (refractive index=1.33), then what would be new Numerical aperture and Acceptance angle.

8. Calculate the critical angle for total internal reflection in an optical fiber with a core refractive index of 1.5 and a cladding refractive index of 1.45.

9. What is the V-number in an optical fiber? What is the general formula for the V-number? How does the V-number depend on the Numerical Aperture (NA)? How does this dependence dictate Single-Mode vs. Multi-Mode fiber design?

10. A step index fiber has a core refractive index 1.52, a diameter of 29 μm and a fractional refractive index difference of 0.0007. It is operated at a wavelength of 1.3 μm. Calculate the fiber V-number and number of modes that fiber will support.

11. Internal critical angle at core-cladding interface of a step-index fiber is 80.6 o . Calculate maximum acceptance angle when cladding refractive index is 1.48.

12. An optical fiber has numerical aperture of 0.20 and cladding refractive index of 1.59. Determine the acceptance angle for the fiber in the water.

13. Describe the various ways of fibre losses? The signal attenuation per kilometer of an optical fiber of length 8km is 1.5dB/km. Calculate the mean optical input power of the fiber if mean optical output power is 20 μW.

14. If the input power to an optical fiber is 2 mW and the output power after a certain distance is 0.5 mW, calculate the attenuation in dB.

15. An optical fiber link of length 10 km has an attenuation of 0.2 dB/km. Calculate the total loss in the fiber link.

16. 15. What are the advantages of using optical fibers over traditional copper cables for data transmission?

17. Discuss the phenomenon of pulse dispersion in optical fibers by defining its underlying physical mechanism, detailing its primary types—including modal, chromatic, and polarization mode dispersion—and explaining how this phenomenon limits the data transfer rate, transmission distance, and overall performance of an optical communication link.