GURU TEGH BAHADUR INSTITUTE OF TECHNOLOGY
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Subject: Optical Communication	
QUESTION BANK-1	**Branch:** ECE/EEE 7th Semester
Topic : Optical communication	**Lecturer**: Amrish Kumar, Kalyan Singh, Disha Bathla

1. The velocity of light in the core of a step index fiber is 2.01×10^{8} ms^{-1}, and the critical angle at the core cladding interface is 80^{0}. Determine the numerical aperture and the acceptance angle for the fiber in air, assuming it has a core diameter suitable for consideration by ray analysis. The velocity of light in vacuum is 3×10^{8} ms^{-1}.

2. Define the relative refractive index difference for an optical fiber and show how it may be related to the numerical aperture.

3. A step index fiber with a large core diameter compared with the wavelength of the transmitted light has an acceptance angle in air of 22^{0} and a relative refractive index difference of 3%. Estimate the numerical aperture and the critical angle at the core cladding interface for the fiber.

4. A step index fiber has a solid acceptance angle in air of 0.115 radians and a relative refractive index difference of 0.9%. Estimate the speed of light in the fiber core.

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

6. Explain what is meant by a graded index optical fiber, giving an expression for the possible refractive index profile. Using simple ray theory concepts, discuss the transmission of light through the fiber. Indicate the major advantage of this type of fiber with regard to multimode propagation.

7. A multimode graded index fiber has an acceptance angle of air of 8^{0}. Estimate the relative refractive index difference between the core axis and the cladding when the refractive index of the core axis is 1.52.

8. A single mode step index fiber has a core diameter of 7 µm and a core refractive index of 1.49. Estimate the shortest wavelength of light which allows single-mode operation when the relative refractive index difference for the fiber is 1%.

9. It is required to increase the fiber core diameter to 10 µm whilst maintaining single mode operation at the same wavelength. Estimate the maximum possible relative refractive index difference for the fiber.

10. A single mode step index fiber which is designed for operation at a wavelength of 1.3 µm has core and cladding refractive indices of 1.447 and 1.442 respectively.

When the core diameter is 7.2 µm, confirm that the fiber will permit single mode transmission and estimate ether angle of wavelengths over which this will occur.

11. The mean optical power launched into an optical fiber link is 1.5 mW and the fiber has an attenuation of 0.5 dB km^{-1}. Determine the maximum possible link length without repeaters, when the minimum mean optical power level required at the detector is 2µW.

12. The numerical input / output mean optical power ratio in a 1 km length of optical fiber is found to be 2.5. Calculate the received mean optical power when a mean optical power of 1 mw is launched into a 5 km length of the fiber.

13. A 15 km optical fiber link uses fiber with a loss of 1.5 dB km^{-1}. The fiber is jointed every kilometer with connectors which give an attenuation of 0.8 dB each. Determine the minimum mean optical power which must be launched into the fiber in order to maintain a mean optical power level of 0.3 µW at the de3tector.

14. Discuss absorption losses in optical fibers, comparing and contrasting the intrinsic and extrinsic absorption mechanisms.

15. Briefly describe linear scattering losses in optical fibers with regard to
    a. Raleigh scattering
    b. Mie scattering

16. An 11 km optical fiber link consisting of optimum near parabolic profile graded index fiber exhibits rms intermodal pulse broadening of 346 ps over its length. If the fiber has a relative refractive index difference of 1.5%, estimate3 the core axis refractive index. Hence determine the numerical aperture for the fiber.

17. the material dispersion in an optical fiber defined by $d^2n1/d\lambda^2$ is 4×10^{-2} μm^{-2}. Estimate the pulse broadening per kilometer due to the material dispersion within the fiber when it is illuminated with an LED source with a peak wavelength of 0.9 µm and an rms spectral width of 45 nm.

18. A single step index fiber with a core refractive index1.49 has a critical bending radius of 10.4 mm when illuminated with light at a wavelength of 1.30 µm. If the cutoff wavelength for the fiber is 1.15 µm calculate its relative refractive index difference.

19. Explain what is meant by self phase modulation. Identify and discuss a major application area for this nonlinear phenomenon.

20. Discuss modal noise in optical fibers suggest how it can be avoided.