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KS

TUTORIAL OPTICAL FIBERS
(Term: Aug to Dec 2019)

1. An optical fiber has a core refractive index of 1.55 and cladding refractive index of 1.49. Calculate the following: (i) numerical aperture (ii) angle of acceptance (iii) fractional index change (iv) critical angle and (v) velocity of light in the core of the optical fiber. The fiber is placed in air.
2. An optical fiber has core R.I. =1.54 and fractional change in refractive index equal to 0.0006. The fiber is placed in water. Calculate (i) NA, (ii) cladding refractive index, (iii) critical angle and (iv) angle of acceptance.
3. Calculate numerical aperture in water, fractional index change, internal critical angle and angle of acceptance of an optical fiber of core and clad refractive indices 1.53 and 1.525 respectively.
4. The angle of incidence for a ray in a step-index fiber for which n_1=1.5 is 11°. Compute the refractive index of the cladding material. with fiber axis so that critical angle at core cladding interface
5. Consider a multimode step index fiber with $n_1 = 1.54$ and $n_2 = 1.50$ and λ=1 μm. if the core radius is 70 μm then calculate the normalized frequency of the fiber (V) and the number of guided modes.
6. The number of modes in a step index fiber is 3500. The diameter of the core is 150μm and numerical aperture is 0.25. Calculate the operating wavelength. If the same fiber is to be used for single mode operation what should be the operating wavelength?
7. The relative refractive index (fractional index change) of an optical fiber is 3% for a core refractive index of 1.55. The diameter of the fiber is 100μm. Calculate the number of modes for an operating wave length of 80 μm.
8. Calculate diameter of core if an optical fiber has to support 1245 modes for a carrier wavelength of 0.86 μm. Core refractive index is 1.55, fractional index change is 2×10^{-3} and the fiber is kept in water.
9. An optical fiber has a core Refractive index of 1.55 and fractional change in R.I. is 0.0075. What should be the diameter of the fiber core to support 500 modes at an operating wavelength 80 μm?
10. The core of a single mode fiber is 5 μm and the refractive indices of core and cladding are 1.5 and 1.45 respectively. Calculate the operating wavelength. If the core diameter is doubled, calculate the required refractive index of the cladding in order to maintain single mode transmission.

4.) An optic glass fiber of refractive index 1.50 is to be clad to ensure total internal reflection that will contain light travelling with in 11° of the fiber axis. What maximum index of refraction is allowed for the cladding.

11. An optical fiber has a numerical aperture of 0.2 and critical angle of 80°. The core diameter is 10 μm. what should be the operating wavelength for single mode propagation? Calculate the cladding refractive index.
12. An input power of 10W is reduced to 1W after 12.5km of an optical fiber. Calculate the attenuation coefficient.
13. A fiber 750 m long has an input power of 90 mW and an output power of 80 mW. Calculate the signal attenuation coefficient. What will be the output intensity if the fiber length is increased to 5 km?
14. The output is 75% when a signal travels 10 km in an optical fiber. Calculate the attenuation coefficient. If the input signal intensity is 10 mW, what is the output signal intensity after 5 km?
15. The output is 60% of the input when the signal travels through 1 km. Calculate the output after 4km for an input signal intensity of 100 mW.
16. Calculate the power input to an optical fiber of attenuation coefficient 3.2dBkm^{-1}, length 5000m, so that the output power is 35mW.
17. Calculate the allowed length of an optical fiber of attenuation coefficient 2.1dBkm^{-1} to get 50mW output when the input is 1W.
18. An optical fiber of attenuation coefficient 2.6dBkm^{-1} is coupled to an LED of efficiency 0.55. Calculate the input power to the LED to get 5mW power output from 4.5km the optical fiber. Assume the coupling loss to be zero.