

EE1002 Principles of Electronic Engineering
Semester A 2015-16
Part 3: Electromagnetic Waves and Applications

Tutorial 3

1. A silica multimode optical fiber has a core refractive index of 1.50 and a cladding refractive index of 1.47. Determine (a) the critical angle at the core-cladding interface; (b) the numerical aperture (NA) of the fiber; (c) maximum acceptance angle in air for the fiber.
2. A typical relative refractive index difference for a multimode optical fiber designed for long distance transmission is 1%. Estimate the NA and the critical angle at the core-cladding interface with the fiber, assuming the core index is 1.46.
3. When the mean optical power launched into an 8 km length of fiber is 120 μW , the mean optical power at the fiber output is 3 μW . Determine (a) the overall signal attenuation of loss in dB through the fiber assuming there are no splices or connectors; (b) the signal attenuation per kilometer for the fiber; (c) 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; (d) the input/output power ratio in (c).
4. A 5 km optical link consists of a multimode step-index fiber with a core refractive index of 1.48 and a relative refractive index difference of 1%. Estimate the delay difference between the slowest and fastest rays at the fiber output (i.e., the pulse broadening δT) and the maximum bit rate that the fiber link can support. What will be the maximum bit rate of the fiber, if it is 1 km long?
5. Determine the cutoff 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 , respectively, with the relative index difference being 0.25%.
6. A single-mode step-index fiber 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 the range of wavelengths for single-mode operation of the fiber.

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