TUTORIAL 03 :

OPTICAL COMMUNICATIONS

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Tutorial 03 : Optical communications

Exercise 1:

A silica optical fiber with a core diameter large enough to be considered by ray theory analysis 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 NA for the fiber;

(c) The acceptance angle in air for the fiber;

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Exercise 2:

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) The normalized frequency for the fiber;

(b) The number of guided modes;

(c) Estimate the maximum core diameter for single-mode;

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(d) 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%.

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Exercise 3:

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:

(a) The total number of guided modes propagating in the fiber when it is operating at a wave- length of 1 μm.

(b) New maximum core diameter for single-mode operation when the relative refractive index difference is reduced by a factor of 10.

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Exercise 4:

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 or loss in decibels through the fiber assuming there are no connectors or splices;

(b) the signal attenuation per kilometer for the fiber;

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(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 numerical input/output power ratio in (c);