

Silicon Photonics Homework #3

HW 3-1.

For the Corning SMF-28™ step-index single-mode optical fiber with a relative refractive index difference $\Delta = 0.0036$, a core diameter $2a = 8.2 \mu\text{m}$, and a core index $n_1 = 1.468$, please find

- the normalized frequency V at $\lambda_0 = 1.55 \mu\text{m}$
- the normalized propagation constant b (using the fitting curve in b - V diagram) at $\lambda_0 = 1.55 \mu\text{m}$
- the effective index $N (= \beta/k_0)$ at $\lambda_0 = 1.55 \mu\text{m}$
- the mode field diameter $2w_0$ at $\lambda_0 = 1.55 \mu\text{m}$
- if the group velocity dispersion (GVD) $D = 17 \text{ ps/nm}\cdot\text{km}$ at $\lambda_0 = 1.55 \mu\text{m}$ and a laser with a spectral width $\Delta \lambda = 0.1 \text{ nm}$ is used as the signal source, what is the maximum bit rate B_T due to chromatic dispersion?
- what is the numerical aperture NA of the optical fiber?
- for single mode operation, what is the cut-off wavelength λ_c ?

HW 3-2.

For the Corning SMF-28™ step-index single-mode optical fiber with a relative refractive index difference $\Delta = 0.0036$, a core diameter $2a = 8.2 \mu\text{m}$, and a core index $n_1 = 1.458$, please find

- the normalized frequency V at $\lambda_0 = 1.31 \mu\text{m}$
- the normalized propagation constant b (using the fitting curve in b - V diagram) at $\lambda_0 = 1.31 \mu\text{m}$
- the effective index $N (= \beta/k_0)$ at $\lambda_0 = 1.31 \mu\text{m}$
- the mode field diameter $2w_0$ at $\lambda_0 = 1.31 \mu\text{m}$
- if the group velocity dispersion (GVD) $D = 0.01 \text{ ps/nm}\cdot\text{km}$ at $\lambda_0 = 1.31 \mu\text{m}$ and a laser with a spectral width $\Delta \lambda = 0.1 \text{ nm}$ is used as the signal source, what is the maximum bit rate B_T due to chromatic dispersion?

HW 3-3.

For a step-index multimode fiber with a core diameter $2a = 100 \mu\text{m}$, a core index $n_1 = 1.48$ and a cladding index $n_2 = 1.46$, please find

- the normalized frequency V at $\lambda_0 = 0.85 \mu\text{m}$
- the number of modes $M (\approx V^2/2)$
- the maximum bit rate B_T due to intermodal (multimode) dispersion.