UNIT-3

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1 Fiber alignment and joint loss

Loss due to Fresnel reflection

$$r = \left(\frac{n_1 - n}{n_1 + n}\right)^2 \quad \text{fraction of light reflected}$$
$$\text{Loss}_{Fres} = -10 \log_{10}(1 - r) \tag{1}$$

1.1 Multimode fiber joints

Lateral Misalignment Loss

$$\eta_{lat} = \frac{16(n_1/n)^2}{[1 + (n_1/n)]^4} \frac{1}{\pi} \left\{ 2\cos^{-1}\left(\frac{y}{2a}\right) - \left(\frac{y}{a}\right)\left[1 - \left(\frac{y}{2a}\right)^2\right]^{1/2} \right\}$$
$$\text{Loss}_{lat} = -10 \log_{10} \eta_{lat} \tag{2}$$

for small lateral offset

$$L_t = \frac{2}{\pi}\left(\frac{y}{a}\right)\left(\frac{\alpha + 2}{\alpha + 1}\right) \quad \text{for } 0 \le y \le 0.2a$$
$$\eta_{lat} = 1 - L_t \tag{3}$$

Angular Misalignment Loss

$$\eta_{ang} = \frac{16(n_1/n)^2}{[1 + (n_1/n)]^4} \left[1 - \frac{n\theta}{\pi n_1 (2\Delta)^{1/2}}\right]$$
$$\text{Loss}_{ang} = -10 \log_{10} \eta_{ang} \tag{4}$$

Loss due to core diameter mismatch

$$\text{Loss}_{CD} = \begin{cases} -10 \log_{10}\left(\frac{a_2}{a_1}\right)^2 & a_2 < a_1 \\ 0 & a_2 \ge a_1 \end{cases} \tag{5}$$

Loss due to NA mismatch

$$\text{Loss}_{NA} = \begin{cases} -10 \log_{10}\left(\frac{NA_2}{NA_1}\right)^2 & NA_2 < NA_1 \\ 0 & NA_2 \ge NA_1 \end{cases} \tag{6}$$

Loss due to Refractive Index mismatch

$$\text{Loss}_{RI} = \begin{cases} -10 \log_{10} \left(\dfrac{\alpha_2(\alpha_1 + 2)}{\alpha_1(\alpha_2 + 2)} \right)^2 & \alpha_2 < \alpha_1 \\ 0 & \alpha_2 \geq \alpha_1 \end{cases} \tag{7}$$

Intrinsic Loss

$$\text{Loss}_{int} = \text{Loss}_{CD} + \text{Loss}_{NA} + \text{Loss}_{RI} \tag{8}$$