[1]

$$P_C = -8\ dB_m \qquad \alpha = 6\ dB/km.$$
$$P_o = P_C - \alpha L \quad [dB]$$
$$= -8 - 6(2) = -20\ dB_m$$
$$P_o = 10^{-20/10}\ mW = 10^{-2}\ mW = 10\ \mu W.$$

[2] The same equations in [1] ➔ L = 3.67 Km

[3]
$$\tau_m = D_m \times L \times \Delta\lambda_o$$
$$= 84.2\,(\text{ps/km.nm}) \times 1\,(\text{km}) \times 20\,(\text{nm}) = 1700\,\text{ps}$$

[4] It is given that $n_1 = 1.45$ and $\Delta = 0.003$.

$$\Delta = \frac{n_1 - n_2}{n_1} \implies n_2 = n_1(1-\Delta) = 1.4456$$

$$V = \frac{2\pi a}{\lambda} NA \quad \text{where} \quad NA = n_1\sqrt{2\Delta}$$

At $\lambda = 1.3\ \mu m$ ➔ V = 2.2256

$$V\frac{d^2(Vb)}{dV^2} \approx 0.08 + 0.549(2.834 - V)^2$$
$$= 0.2832$$

$$D_w(\lambda) = -\frac{n_2\Delta}{c\lambda} V \frac{d^2(Vb)}{dV^2}$$
$$= \frac{-1.4456 \times 0.003}{(3\times10^8\ \text{m/s})(1.3\mu\text{m})}(0.2832)$$
$$= -3.149\ \text{ps/(nm.km)}$$

[5] $\frac{\Delta\tau}{L} = D_{ch}\Delta\lambda = 8\times 2 = 16\,\text{ps.km}^{-1}$

$\therefore BL \approx \frac{0.5}{D_{ch}\Delta\lambda} = 31.25\,\text{Gb.s}^{-1}\text{.km}$

[6] Solve it by your self

[7] P_T = 100 mw = 10 log (10^{-1}W/1mW) = -10 dBm

R_S = 1mw= 10 log (10^{-3}W/1mW) = -30 dBm

System gain = P_T - R_S = -10 - (-30) = 20 dB

Cable loss = 40 km x 0.3= 12 dB

Total Losses = 12 dB + 2 dB= 14 dB

System margin = System gain - losses = 20 - 14 = 6 dB

[8] Solve it by your self

Good Luck

Dr. Sherif Hekal