EECE 598, Homework 02, SOULTIONS

3.2 Since the attenuations are given in dB/km, first find the power levels in dBm for 100 μW and 150 μW. These are, respectively,

P(100 μW) = 10 log (100 μW/1.0 mW) = 10 log (0.10) = - 10.0 dBm

P(150 μW) = 10 log (150 μW/1.0 mW) = 10 log (0.15) = - 8.24 dBm

(a) At 8 km we have the following power levels:

P_{1310}(8 km) = - 8.2 dBm – (0.6 dB/km)(8 km) = - 13.0 dBm = 50 μW

P_{1550}(8 km) = - 10.0 dBm – (0.3 dB/km)(8 km) = - 12.4 dBm = 57.5 μW

(b) At 20 km we have the following power levels:

P_{1310}(20 km) = - 8.2 dBm – (0.6 dB/km)(20 km) = - 20.2 dBm = 9.55 μW

P_{1550}(20 km) = - 10.0 dBm – (0.3 dB/km)(20 km) = - 16.0 dBm = 25.1 μW

3.3 From Eq. (3.1c) with $P_{out} = 0.45\ P_{in}$

α = (10/7.0 km) log (1/0.45) = 0.5 dB/km

3.4 (a) $P_{in} = P_{out}\ 10^{\alpha L/10} = (2.0\ \mu W)\ 10^{0.4(40)/10} = 79.6\ \mu W = -11$ dBm

(b) $P_{in} = P_{out}\ 10^{\alpha L/10} = (2.0\ \mu W)\ 10^{0.6(40)/10} = 502\ \mu W = -3$ dBm

3.13 (a) From Fig. 3.13, $\frac{d\tau}{d\lambda} \approx 80$ ps/(nm-km) at 850 nm. Therefore, for the LED we have from Eq. (3.28)

$$\frac{\sigma_{mat}}{L} = \frac{d\tau}{d\lambda}\ \sigma_\lambda = [80 \text{ ps/(nm-km)}](45 \text{ nm}) = 3.6 \text{ ns/km}$$

For a laser diode,

$$\frac{\sigma_{mat}}{L} = [80 \text{ ps/(nm-km)}](2 \text{ nm}) = 0.16 \text{ ns/km}$$

(b) From Fig. 3.13, $\frac{d\tau_{mat}}{d\lambda} = 22$ ps/(nm-km)

Therefore, $D_{mat}(\lambda) = [22 \text{ ps/(nm-km)}](75 \text{ nm}) = 1.65$ ns/km

3.17 Plot of Eq. (3.47).

3.18 (a) $D = (\lambda - \lambda_0) S_0 = -50\ (0.07) = -3.5$ ps/(nm·km)

(b) $$D = \frac{1500(0.09)}{4}\left[1 - \left(\frac{1310}{1500}\right)^4\right] = 14.1 \text{ ps/(nm·km)}$$