EE 230 Fall 2002

Homework #6

Read: 5.1, 5.2, 5.3*, 5.4*

1. Given the following component specifications:
   Laser diode: wavelength $\lambda = 1.3\mu m$
   - linewidth $\Delta \lambda = 5nm$
   - risetime $T_{rr} = 1ns$
   - output power $P_{tr} = 1mW$

   Fiber: Step-index multi-mode fiber with $NA = 0.24$
   - loss coefficient $\alpha_f = 0.8dB/km$
   - core index of refraction $n_1 = 1.47$
   - dispersion parameter $D = 1 \text{ ps/(km-nm)}$

   Receiver: p-i-n photodiode with responsivity $0.6 \text{ A/W}$
   - temperature $T = 300 \text{ K}$
   - load resistor $R_L = 7073\Omega$
   - bandwidth $\Delta f = 4.8 \text{ MHz}$
   - amplifier noise figure $F_n = 1.5$
   - rise time $T_r = 75ns$

   (a) Calculate the receiver sensitivity for a BER = $10^{-9}$, assuming the receiver is thermal noise limited.

   (b) If you are asked to design a system that transmits a digital signal at $B = 2Mb/s$ over a 10 km distance, calculate the power budget and rise time budget for the system using the above components. Assuming 1 dB connector loss at each end of the fiber link, 0.1 dB/km splice loss, and 6 dB system margin. Are these components adequate for NRZ signals? Are these components adequate for RZ signals?

2. A distribution network uses an optical bus to distribute the signal to 10 users. Each optical tap couples 10% of the power to the user and has 1-dB insertion loss. Assuming that station 1 transmits 1 mW of power over the optical bus, calculate the power received by stations 8, 9, and 10.

3. Prove that the rise time $T_r$ and the 3-dB bandwidth $\Delta f$ of a RC circuit are related by $T_r \Delta f = 0.35$. 