

EECE 598, Homework 06

Try to solve the problems by yourselves. Compare with your solutions after you are done.
Exams will be similar formats as these.

1. **Problem 8-1.**
2. **Problem 8-2.**
3. **Problem 8-9.**

No submission is required. The solutions to select problems will be uploaded a week later.

8.1 Make a graphical comparison, as in Fig. 8.4, and a spreadsheet calculation of the maximum attenuation-limited transmission distance of the following two systems operating at 100 Mb/s:

System 1 operating at 850 nm

- (a) GaAlAs laser diode: 0-dBm (1-mW) fiber-coupled power.
- (b) Silicon avalanche photodiode: -50-dBm sensitivity.
- (c) Graded-index fiber: 3.5-dB/km attenuation at 850 nm.
- (d) Connector loss: 1 dB/connector.

System 2 operating at 1300 nm

- (a) InGaAsP LED: -13-dBm fiber-coupled power.
- (b) InGaAs *pin* photodiode: -38-dBm sensitivity.
- (c) Graded-index fiber: 1.5-dB/km attenuation at 1300 nm.
- (d) Connector loss: 1 dB/connector.

Allow a 6-dB system operating margin in each case.

8.2 An engineer has the following components available:

- (a) GaAlAs laser diode operating at 850 nm and capable of coupling 1 mW (0 dBm) into a fiber.
- (b) Ten sections of cable each of which is 500 m long, has a 4-dB/km attenuation, and has connectors on both ends.
- (c) Connector loss of 2 dB/connector.
- (d) A *pin* photodiode receiver.
- (e) An avalanche photodiode receiver.

Using these components, the engineer wishes to construct a 5-km link operating at 20 Mb/s. If the sensitivities of the *pin* and APD receivers are -45 and -56 dBm, respectively, which receiver should be used if a 6-dB system operating margin is required?

as can be seen from Fig. 3.13.

- 8.9.** A 1550-nm single-mode digital fiber optic link needs to operate at 622 Mb/s over 80 km without amplifiers. A single-mode InGaAsP laser launches an average optical power of 13 dBm into the fiber. The fiber has a loss of 0.35 dB/km, and there is a splice with a loss of 0.1 dB every kilometer. The coupling loss at the receiver is 0.5 dB, and the receiver uses an InGaAs APD with a sensitivity of -39 dBm. Excess-noise penalties are predicted to be 1.5 dB. Set up an optical power budget for this link and find the system margin. What is the system margin at 2.5 Gb/s with an APD sensitivity of -31 dBm?

8.10 Make a plot of the extinction ratio versus