

HW #5

due 3/1/18 5PM

no later than 3/6/18 5PM

1. a) Assuming length of the fiber is L , find the delay owing to dispersion for the fiber in HW 4 Problem 2.
b) Find the data rate times distance product $R_b \times L$ for the fiber in HW 4 Problem 2.
c) Assuming length of the fiber is L , find the delay owing to dispersion for the fiber in HW 4 Problem 4.
d) Find the data rate times distance product $R_b \times L$ for the fiber in HW 4 Problem 4.
2. a) Consider a standard non-dispersion-shifted single mode fiber that has a zero-dispersion wavelength at 1310nm with a dispersion slope of $S_0 = 0.09 \text{ ps}/(\text{km} - \text{nm}^2)$. Plot the dispersion in the wavelength range $1200 \text{ nm} \leq \lambda \leq 1400 \text{ nm}$ with computer.
b) A typical dispersion-shifted single-mode fiber has zero-dispersion wavelength 1550nm with a dispersion slope of $0.070 \text{ ps}/(\text{km} - \text{nm}^2)$. Plot the dispersion in the wavelength range $1500 \text{ nm} \leq \lambda \leq 1600 \text{ nm}$ with computer.
3. A certain optical fiber has an attenuation of 0.5dB/km at 1330nm and 0.2dB/km at 1550nm. Suppose the following two optical signals are launched simultaneously into the fiber: an optical power of $300 \mu\text{W}$ at 1330 nm and an optical power of $150 \mu\text{W}$ at 1550 nm. What are the power levels in μW of these two signal at (a) 1km and (b) 5 km?
4. A system has a transmitter with power of 5mW and a receiver requires at least 0.5mW for reliable reception. a) If we use a fiber with attenuation of 0.6dB/km, what is the maximum length of the fiber without repeater?
b) If our communication system must be 40km long without repeater, what should be the attenuation of the fiber?

Extra-Credit for undergraduate (regular for graduate)

5. A $1.3 \mu\text{m}$ lightwave system uses a 55km fiber link and requires at least $0.4 \mu\text{W}$ at the receiver. The fiber loss is 0.55dB/km. Fiber is spliced (fused together owing to standard spool only having certain length) every 5 km and has two connectors of 1dB at both ends. Splice loss is only 0.2dB. Determine the minimum power that must be launched into the fiber.

Extra-credit

6. a) For the fiber in problem 4 HW4, what is the maximum fiber length without repeater if the required data rate is 10Gb/s?
b) Suggest one way to double length in a) without changing the fiber parameters, i.e. you cannot replace the fiber but can splice another spool of the same type of fiber to extend the length. Demonstrate your idea with calculations.
c) For the system in problem 4 a), Suggest one method to double the distance without repeater without changing the fiber parameters. Demonstrate your idea with calculations. (5 points)