

Assignment 2

Due Tuesday, November 14. Show your work. Submit your assignment using the appropriate dropbox on the course web site. Assignments submitted after the solutions are made available will be given a mark of zero.

Question 1

You are trying to decide which of two frequencies, 2.4 or 5 GHz, will provide a higher received signal power for a point-to-point link. The transmit and receive antennas both have effective areas of $A_e = 0.5 \text{ m}^2$. Other parameters (e.g. transmit power, distance) are the same for both systems.

- Which frequency results in a higher path loss (defined as $(\frac{\lambda}{4\pi d})^2$)?
- Which frequency would you choose? Why?
- Would your conclusion change if: (i) one antenna was omni-directional (gain = 0 dB)? (ii) both antennas were omni-directional?

Question 2

Look up the datasheet for Corning SMF-28 single-mode fiber.

- Based on the refractive index (ϵ_r) what is the velocity of propagation?
- What is the attenuation for a 20 km link at a 1550 nm wavelength?
- A signal with a bandwidth of 10 GHz is being transmitted at a center wavelength of 1530 nm.
 - What is the bandwidth as a fraction of the optical signal's frequency?
 - What is the wavelength span corresponding to this fraction (in nm)?
 - What is the maximum (chromatic) dispersion for the 20 km link (in ps)?
 - If the symbol rate is 1 GHz, what is the ratio of dispersion to symbol duration?

Question 3

You measure the delay of a 1 kHz tone through a channel as 5 seconds. The delay at 1.1 kHz is mea-

sured to be 100 μs more. If the delay increases approximately linearly over this frequency range, what is delay at 1.05 kHz? What is group delay at this frequency?

Question 4

The number of lightning strikes per month on a company's facilities is found to be approximately normally distributed with a mean of 10 and a standard deviation of 6.

- What is the probability there will be more than 20 lightning strikes in one month?
- What is the probability there are fewer than -2 lightning strikes?

Question 5

Assuming a low-to-high transition encodes a '1' bit, draw the waveform that would be used to transmit an 8-bit-long 10 Mb/s Manchester-encoded dotting sequence (alternating 1's and 0's) beginning with a 1. What is the frequency of the Manchester-encoded waveform?