

Assignment 2

Due Monday, May 2. 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

A communication system transmits 16 Mb/s using different, equally-spaced voltage levels. The symbol duration is $0.25 \mu\text{s}$.

- How many voltage levels are used?
- How many decision thresholds does the receiver need?
- The peak-to-peak voltage of the received signal is $2 V_{pp}$. What is the noise margin?
- The signal is corrupted with AWGN with a noise power of 50 mVrms . What is the approximate symbol error rate¹?

Question 2

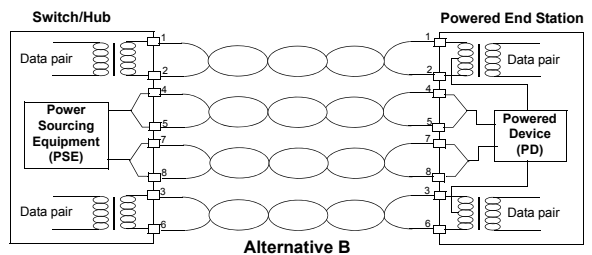
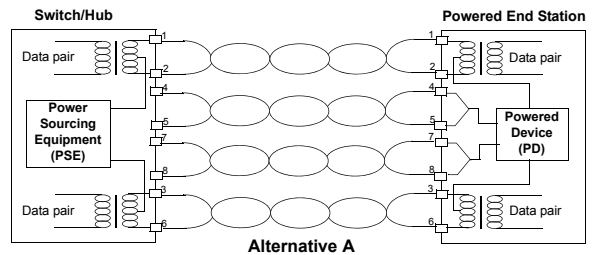
A signal source has an open-circuit voltage of $2 V_{rms}$ and a purely resistive source impedance of 100 ohms .

- what is the current, expressed as a complex number, if you connect a load with an impedance of $100 + j100 \text{ ohms}$? How much (real) power is dissipated in the load?
- How does the answer change if the source impedance is changed to $100 - j100 \text{ ohms}$?
- How large a capacitor adds a reactance of $-j100 \text{ ohms}$ at a frequency of 100 MHz ?

Question 3

The diagram below, from the IEEE 802.3 standard, shows the two ways that are used to supply power over Ethernet (PoE):

¹You can approximate the symbol error rate as the probability that the noise exceeds the noise margin.



- Assuming a voltage at the PSE of 48 V , a 100 mA long cable using 24 -gauge conductors and a current of 500 mA , how much power is being supplied to the load? How much is being consumed by the cable?
- Look at the datasheet for the Bel-Fulse 0813-1X1T-57-F Modular RJ-45 jack with magnetics (on the course web site). Which of the PoE modes are supported by this device? What is the rated isolation voltage (“HiPot”)?

Question 4

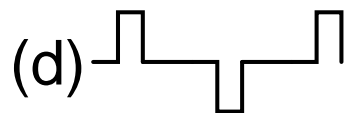
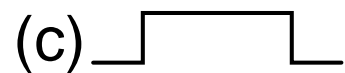
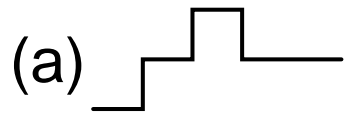
A simple point-to-multipoint network uses polling. Each poll message and the shortest response message consists of header containing 48 bits . The data rate is 100 kb/s .

- If there are 32 slaves (“secondary stations”) and one master (“primary stations”), what is the minimum time between polls to a given station? Assume each poll is answered with a the shortest possible response.
- If each of the slaves transmits a response containing 32 bytes of payload in addition to the header,

what is the new time between polls?

Question 5

What type of line code is being used in each of the following waveforms? They are ones that have been covered in the course and the same number of bits is being transmitted in each case.



Question 6

A wireless OFDM system is using $N = 256$, a sampling rate of 5 MHz and a guard time of $2 \mu s$. What is the subcarrier spacing? What is the symbol duration (not including the guard time)? What is the time between samples (including the guard time)?

Question 7

What is the (Shannon) capacity of a TV channel? Assume a bandwidth of 5 MHz and an SNR of 26 dB.