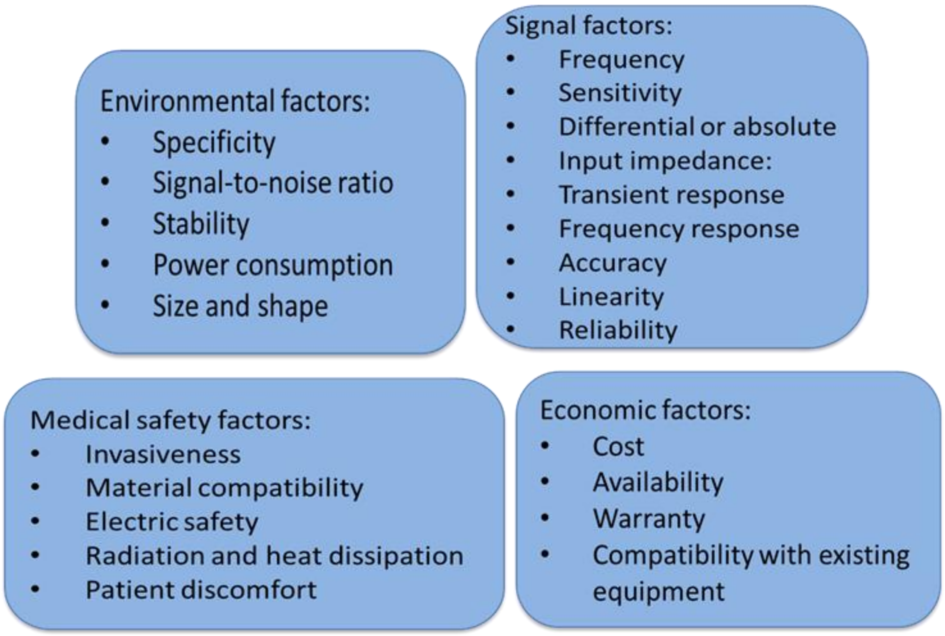
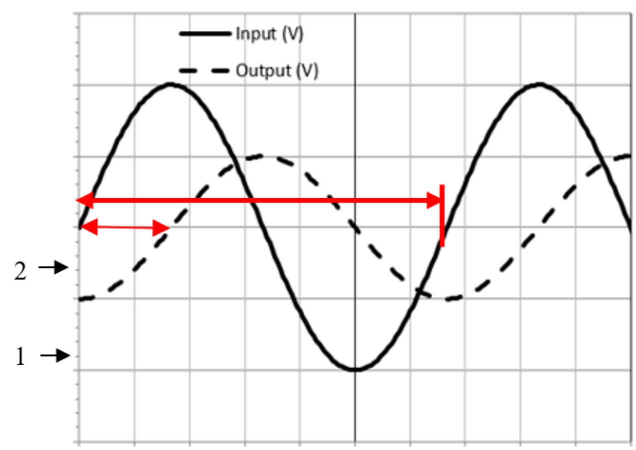
BIEN325: Homework 1 Name: ___________________

1. **(From Lecture 1)** For each of the five categories of design criteria for a biomedical device (Environmental, Signal, Safety, Economics, Social), state one example that was not listed in the PowerPoint presentation.



2. **(From Lecture 1)** Explain why specificity is considered an “Environmental” factor, as opposed to a “Signal” factor.

3. **(From the Tutorial on Oscilloscopes)** Consider the oscilloscope trace shown in the figure below. The voltage gain for the input signal is 0.5 Volts/division, and the voltage gain for the output signal is 0.1 Volts/division. The time base is set on 0.2 msec/divison. The input is on Channel 1, and the output is on Channel 2.



a. What are the peak-to-peak voltages for the input and for the output?$\tau 1 \omega$

b. What is the gain for this system at this frequency?

c. What is the frequency of the two signals?

d. What is the phase lag in degrees between the input signal and the output signal?

e. What are the offsets of the two signals?

4. **(From Lecture 1, "Mean and RMS")** Consider the signal $s(t) = B + A\sin(\omega t)$.
   a. Find the mean and RMS values of this signal, where T is exactly one period of the signal, i.e. $T = \frac{2\pi}{\omega}$. (For the RMS, you can use the integral $\int \sin^2(\omega t)\,dt = \frac{t}{2} - \frac{1}{4\omega}\sin(2\omega t)$.)

   b. Find the mean value of this signal, where T is one and one half period of the signal, i.e. $T = \frac{3\pi}{\omega}$. (For the RMS, you can use the integral $\int \sin^2(\omega t)\,dt = \frac{t}{2} - \frac{1}{4\omega}\sin(2\omega t)$.)

5. **(From Lecture on Basic Concepts, "Magnitude and Phase")** What are the magnitude and phase shift for a system that has the following transfer function.

$$\frac{V_{\text{out}}}{V_{\text{in}}} = K\frac{\tau_1 j\omega}{(\tau_1 j\omega + 1)}$$

6. **(From Lecture on Basic Concepts, "Bode Plot")** Find expressions for the magnitude and phase of the following transfer function, and use Excel to plot these quantities on a Bode plot, with frequency ranging from 0.1 to 10000 Hz. (Use separate plots, with the magnitude plot above the phase plot.)

$$T(s) = \frac{V_{\text{out}}}{V_{\text{in}}} = \frac{s+3}{s^2 + 10s + 100}$$

Graduate Content

Read the Appendix A in Physiological Control Systems (Some Simple Relationships that Will Simplify Your Life). For each topic, c through u, state whether the information is:

1. Completely new to you.
2. Mostly new to you.
3. Review, but with some new information.
4. Almost all review, but with additional insight that you have not seen before.
5. Completely review.
6. So well understood that it is already ingrained in your understanding.