Homework 2

Wednesday, February 17, 2021 3:04 PM

"I pledge my honor I have abided by the Stevens Honor system."

\- Alex [illegible]

1. Two amplifiers are connected in series. The voltage gain of the first amplifier is 8.7 dB and the voltage gain of the second amplifier is 13.4 dB. The input voltage to the first amplifier is 0.1 volts. Determine the output voltage of the second amplifier.

$$dB = 20\log_{10}\left(\frac{V_o}{V_i}\right)$$

$$8.7 = 20\log_{10}\left(\frac{V_o}{.1}\right)$$

$$10^{(.435)} = \frac{V_o}{.1}$$

$$V_o = .27\ V$$

$$13.4 = 20\log_{10}\left(\frac{V_o}{.27}\right)$$

$$10^{(.67)} = \frac{V_o}{.27}$$

$$\boxed{V_o = 1.27\ V}$$

2. What is a principle advantage of a differential amplifier?

It negates any noise in the system ($V_{in}^{+} - V_{in}^{-}$ remains the same).

3. What is the value of the CMRR in an ideal differential amplifier?

The ideal value is infinity.

4. What is the cause of frequency distortion in an amplifier?

When the gain is not always constant with respect to frequency.

5. (Note; there are no units in this problem; units are not required to solve this problem). You are given a sensor which can be modeled as a first-order system. The input to this sensor (the measurand) is a constant applied at t = 0. The constant input is represented by the variable C for t > 0. The initial reading of the sensor (at t = 0) is represented by the variable y_i. Note; $y_i < C$. The time constant of the sensor is given by the variable τ.

$$x_i = C$$

$$y(t) = (y_i - C)e^{-t/\tau} + C$$

90% Response Time $= .90\,(c - y_i)$

$$.90\,(c - y_i) = (y_i - c)\,e^{-t/\tau} + c$$

6. For the sensor described in Problem Five, determine an expression for the rise time of this system. (Note; use the definition of the rise time we discussed at the beginning of our second lecture).

$$y_i + .90\,(c - y_i) = (y_i - c)\,e^{-t/\tau} + c$$

$$y_i + .90\,(c - y_i) = (-y_i + c)\,e^{-t/\tau} + c$$

$$.90 = -e^{-t/\tau} + 1$$