Electrical and Computer Engineering Department
Interfacing Techniques ENCS4380
Homework#1

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Question#1)

A temperature measuring system, with a time constant 2 s, is used to measured temperature of a heating medium, which changes sinusoidal between 250 and 350C with a periodic of 10 s. find the maximum and minimum values of temperature, as indicated by the measuring system and the time lag between the output and input signals

Question#2)

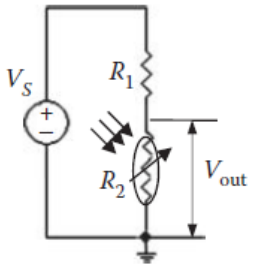
An amplifier in a sensor circuit has a signal voltage level of 4 µV and a noise voltage level of 2 µV at input. If the gain of the amplifier is 40 and a 4 µV of noise is added by the amplifier at the output, determine the signal to noise ratio at output.

Question#3)

The nominal transfer function of an MPX4250A piezoresistive pressure sensor provided by the manufacturer is Vout = Vs(0.004Pin − 0.04), where Vs is the supply voltage (in V), Pin is the input pressure (in kPa), and Vout is the sensor's output (in V). (1) If Vs = 5.1 V, find the sensor's nominal sensitivity and nominal offset. (2) If the supply voltage applied to the sensor fluctuates from 4.85 V DC to 5.35 V DC, that is, Vs = 5.1 ±0.25 V, find the maximum and minimum absolute output error caused by the unstable power supply when measuring a 100 kPa pressure.

Question#3)

The circuit shown in Figure below can be used as a "dark sensor" to turn ON a lighting system automatically in the evening. If R1 = 10 kΩ, Vin = 9 V, and R2 has a resistance of 500 Ω in bright light and 200 kΩ in the dark, find R2's output voltage when (1) R2 is in the bright light; (2) R2 is in the dark.



Question#4)

The approximate time constant of a thermometer is determined by immersing it in a bath and noting the time it takes to reach 63% of the final reading. If the result is 38 s, determine the delay when measuring the temperature of a bath that is periodically changing 3 times per minute

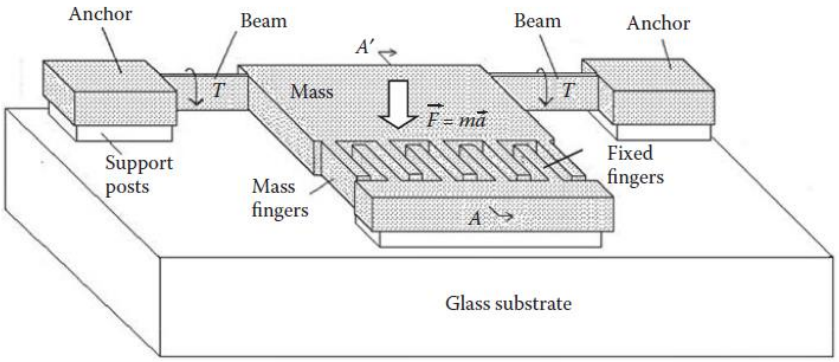
Question#5)

Compare the resistance change produced by a 160 mm · m − 1 strain in a metallic gauge with GF = 2.13 and a semiconductor gauge with GF = − 161.

Assume the nominal resistances for both gauges are 120 Ω.

Question#6)

An area-variation-based capacitive accelerometer, as shown in Figure below, has the following parameters: finger length l_f = 300 µm, mass length l_m = 280 µm, number of fingers n = 100, air gap d_f = 1 µm, and the relative permittivity ε_r = 7. If the measured capacitance change ΔC is 50.34 pF, find the angel θ in degrees (o)



Question#7)

An Accelerometer is selected to measure a time-dependent motion. In particular, input signal frequencies below 200 Hz are of prime interest. Select a set of acceptable parameter specifications for the sensor (i.e. ω_n) , assuming a dynamic error of ±5% and damping ratio ζ =0.6. Use Matlab to verify your results.

Question#8)

Discuss different types of acceleration sensors and Gyroscopes exists today, i.e. in your smart phone. I expect to do the following:

-Discuss concept of operation of the sensor
-Technology used in manufacturing it
-Static and dynamic characteristics of the sensor
-Simple interface to take some measurements from the sensor.

Good Luck