Computer Systems Engineering Department
Interfacing Techniques ENCS436
Homework#1

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Question#1)

(a) A Type-T thermocouple has a measurement error of ±1.1°C. Its transmitter, A/D conversion, display resolution, and wire temperature effect is ±0.6°C. What is the sensor's overall accuracy?

(b) A potentiometric displacement sensor produces a maximum of 20 mV difference when measuring the distance of an object passing a certain point: one measurement is taken when the object moves from the left to the right to the point, and the other is taken when the object moves from the right to the left to the point. Find the hysteresis error if the sensitivity of the sensor is 10 mV/mm.

(c) A photodetector has an RMS signal current of 10 µA, a shot noise current of 3.27 pA, and a thermal noise current of 0.82 pA. Find the current SNR of the photodetector.

(d) An exact pressure of 140 mmHg was applied to a static pressure sensor. Even though the applied pressure never changed, the output values from the sensor over 8 measurements varied as follows: 139, 140,141,142, 138,139,142, 144. Calculate the average output of the sensor and precision of the fifth measurement.

Question#2)

A temperature measuring system, with a time constant 1.5 s, is used to measured temperature of a heating medium, which changes sinusoidal between 300 and 400C with a periodic of 20 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#3)

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 28 s, determine the delay when measuring the temperature of a bath that is periodically changing 2 times per minute

Question#4)

An Accelerometer is selected to measure a time-dependent motion. In particular,

input signal frequencies below 150 Hz are of prime interest. Select a set of acceptable parameter specifications for the sensor (i.e. $\omega_{n)}$, assuming a dynamic error of $\pm$5% and damping ratio ξ =0.6. Use Matlab to verify your results.

Question#5)

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.

Question #6)

Using Tinkercad (online simulator), develop the following simple systems:

(a) Use pushbutton to control a LED, when pressed LED ON, otherwise off. Repeat the experiment when it is pressed the LED is OFF and vice versa. Explain the cncept of pullup/pulldown resistor.

(b) Use potentiometer to control brightness of LED, as the resistor changes the brightness changes.

(c) Use ultrasonic sensor to measure the distance either in meters or inches from an obstacle. Determine the minimum and maximum distance. Display the result on :

- Seven segment Display
- LCD Display

Good Luck