College of Engineering
School of Aerospace Engineering

AE 6705: Introduction to Mechatronics

LAB1

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Table of Contents

Question 1

Solution:
We are given that

$$R_f = 4k\Omega, \qquad R_g = 1k\Omega.$$

We also know that the resistance of the resistor at the non-inverting terminal is computed as the equivalent resistance of the parallel combination of resistors involved in the feedback path ($R - f$ and R_g). Thus,

$$\frac{1}{R_{in}} = \frac{1}{R_f} + \frac{1}{R_g}$$
$$\frac{1}{R_{in}} = \frac{1}{4000} + \frac{1}{1000}$$
$$\frac{1}{R_{in}} = \frac{5}{4000}$$

Hence,

$$\boxed{R_{in} = 800\Omega}$$

Question 2

Solution:
Let one of the resistors have the resistance of $R_1 = 700\Omega$. With the formula for the voltage divider we can compute the other resistance, R_2 to be

$$5 = \frac{R_2}{700 + R_2} 12$$
$$5R_2 + 3500 = 12R_2$$
$$7R_2 = 3500$$

Hence,

$$\boxed{R_1 = 700\Omega, \qquad R_2 = 500\Omega}$$

Question 3

Solution:
If $R_g = 1k\Omega$ and if the sensor amplifier requires a gain of 10, we can compute the other resistance, R_f in the following way.

$$10 = 1 + \frac{R_f}{R_g}$$
$$10 = 1 + \frac{R_f}{1000}$$
$$\frac{R_f}{1000} = 9$$

Hence,

$$\boxed{R_g = 1k\Omega, \quad R_f = 9k\Omega}$$

Question 4

Solution:
The temperature sensor is designed to have $10mV/^{\circ}F$. If 0.4V corresponds to $10^{\circ}F$ which is an output of $100mV$ from the sensor, we can compute the gain to be

$$\boxed{G = 4.}$$

If the MCU reads the voltage in the range of $400mV$ to $5V$, we can tell that the range for the sensor's voltage output will be the range divided by the gain of 4. Hence, the range of $100mV$ to $1025mV$. Since the sensor reads $10mV/^{\circ}F$, we know that the temperature range that can be measured by the MCU is

$$\boxed{10^{\circ}F \ \ to \ \ 102.5^{\circ}F.}$$