## Assignment (Measurements)

a) Explain the operation and usage of the different types of signal conditioning for measurement devices such as filters and amplifiers.

b) Draw a block diagram to show different parts of DAQ system, hence write the required technical specification during the selection of DAQ system.

c) We are given a 12 bit analog input with a range of -10V to 10V. If we put in 2.735V, what will the integer value be after the A/D conversion? What is the error? What voltage can we calculate?

d) For the instrumentation amplifier circuit shown in Figure,

$$R_1 = 5\,k\Omega; \quad R_2 = 20\,k\Omega; \quad R_3 = 15\,k\Omega; \quad R_G = 3\,k\Omega;$$
$$V_1 = 10\,V; \quad V_2 = 15\,V.$$

Determine (a) the gain; (b) the output voltage.
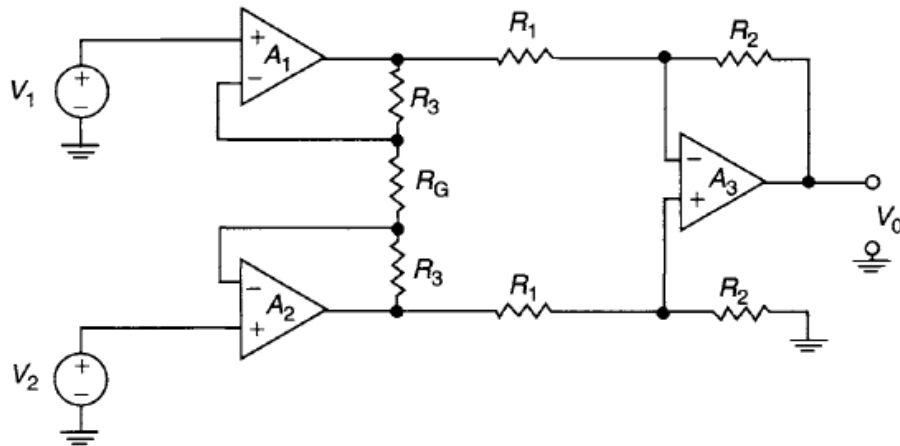
e) Draw the low-pass active filter with input resistance R1,

$$R_1 = 5\,k\Omega; \quad R_2 = 20\,k\Omega;$$
$$C = 2\,\mu F.$$

Determine the closed-loop gain and the decibel value at which the filter rolls off.

f) Draw the summing amplifier with output resistance Rf, so determine the following:

$$R_F = 10\,k\Omega; \quad R_1 = 6\,k\Omega; \quad R_2 = 6\,k\Omega; \quad R_3 = 6\,k\Omega;$$

$$V_1 = V_2 = V_3 = 5\,V.$$

Determine the output voltage.

g) Draw the differential amplifier with inputs resistance R1,

$$R_1 = 5\,k\Omega; \quad R_2 = 15\,k\Omega;$$
$$V_1 = 10\,V; \quad V_2 = 15\,V.$$

Determine the output voltage for these values and for when $R^\wedge = R2$.

h) You need to read an analog voltage that has a range of -10V to 10V to a precision of +/- 0.05V. What resolution of A/D converter is needed?

i) We are given a 12 bit analog input with a range of -10V to 10V. If we put in 2.735V, what will the integer value be after the A/D conversion? What is the error? What voltage can we calculate?

j) A first order instrument is to measure signals with frequency content up to 100 Hz with an inaccuracy of 5%. What is the maximum allowable time constant? What will be the phase shift at 50 and 100 Hz?