Sheet 1: Analog Input/Output

1- Read the data in the input analogue port (x) and output the analogue value(y):
   a) $Y = \frac{x}{3} + 5$
   b) $Y = \frac{32000}{x} * 5 - 2.5$
   c) $Y = \frac{1}{N}\sum_{i=1}^{N} x(i) * T$ where T=10msec, N=4 and x(i) is the value of input x at instant *i*
   d) $Y = \frac{x(i)-x(i-1)}{T}$
2- Read the data in the input analogue port (x) and scale it to:
   a) 100 to 1000 ^{o}C
3- Write a program to read the analogue (x) and analogue input (y) and output analogue value (u):

$$e_i = x_i - y_i,\ e_{i-1} = x_{i-1} - y_{i-1},\ e_{i-2} = x_{i-2} - y_{i-2}$$

$$u_i = u_{i-1} + k_p(e_i - e_{i-1}) + \frac{k_d}{T}(e_i - 2e_{i-1} + e_{i-2}) + \frac{k_i}{N}e_i T$$

4- Find the minimum value and maximum value of u_i in (3).
5- Read the data in the input analogue port (x) for three values and find:
   a) Average
   b) Min and Maximum value
   c) Root mean

$$\sigma = \sqrt{\frac{1}{N}\sum {x_i}^2}$$

6- A process consists of a pressure sensor with an output voltage of 1V/psi. Three indicators are used in the process:
   a) Normal operation (<5 Psi)
   b) Warning condition (>5 Psi & < 7 Psi)
   c) Alarm condition (>7Psi).

Draw a ladder diagram for measuring the pressure and operating the three indicators.

7- A heating tank consists of a temperature and pressure sensor with an output voltage of 0.01V/^{o}C and 0.1V/pal. The process operates operate as follows:
   a) If P<3pal and T<10^{o}C → Heater on
   b) If P>3pa and T>50^{o}C → Heater off
   c) If P>5pa and T<50^{o}C → Safety valve open
   d) If P>5pa and T>50^{o}C → Alarm indicator flash

Draw a ladder diagram for operating the process