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NATIONAL INSTITUTE OF TECHNOLOGY HAMIRPUR (HP)

DEPARTMENT OF MECHANICAL ENGINEERING

END SEMESTER EXAMINATION DEC 2020

Instrumentation and Control for Energy Systems (ME-771)

Date: 17-12-2020, Slot: B (03:00 PM to 05:00 PM), Time: 2:00 hrs, **M.M.**: 50

Note: Attempt all the questions.

1.Draw sketches to illustrate the dynamic characteristic of the following:

(a) zero-order instrument

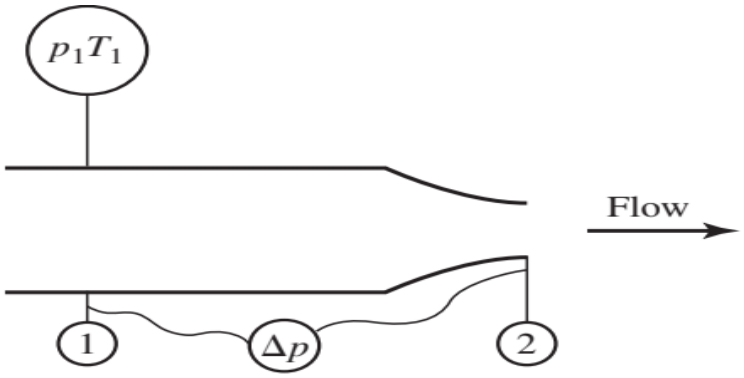
(b) first-order instrument

(c) second-order instrument

In the case of a second-order instrument, indicate the effect of different degrees of damping on the time response. **10**

2. A certain obstruction-type flowmeter (orifice, venture, nozzle), shown in the accompanying figure, is used to measure the flow of air at low velocities. The relation describing the flow rate is

$$\dot{m} = CA\left[\frac{2g_c p_1}{RT_1}(p_1 - p_2)\right]^{1/2}$$



Where C=empirical-discharge coefficient

A=flow area

p_1 and p_2 = upstream and downstream pressures, respectively

T_1=upstream temperature

R=gas constant for air

Calculate the percent uncertainty in the mass flow rate for the following conditions:

C=0.92$\pm$0.005 (from calibration data)

$p_1 = 25 \times 0.068\ bar \pm 0.5 \times 0.068\ bar$

$T_1 = 70°\text{F} \pm 2°\text{F}$

$\Delta p = p_1 - p_2 = 1.4 \times 0.068\ bar \pm 0.005 \times 0.068\ bar$ (measured directly)

$A = 1.0\ in^2 \pm 0.001\ in^2$ **10**

3. Explain what each of the following are about thermocouples: (a) type of thermocouple and its base metal, (b) extension leads, (c) compensating leads, (d) law of intermediate metals, and (e) law of intermediate temperature. **10**

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4. Sketch the block diagram of any A/D and D/A convertor and explain the working principle of these converters with the help of a suitable example. **10**

5. (a) Sketch block diagram of Data Acquisition System and explain briefly the working of each element with the help of suitable example. **5**

(b) Differentiate between 80286 and 80386 microprocessors. **5**

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