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Roll No. :

328512(28)

B. E. (Fifth Semester) Examination, 2020

APR-MAY

(Old Scheme)

(Et. & T Engg.)

INDUSTRIAL INSTRUMENTATION

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Attempt all questions. Part (a) is compulsory from each question. Attempt any two parts from (b), (c) and (d).

1. (a) Define the following terms

Time constant, settling time, Dynamic Range

Measurement lag

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- (b) Sketch and explain the response of a first order system when subjected to ramp input signal. Indicate the transient error, steady state error and time lag. 7
- (c) What is calibration and why it is necessary for an instrument?

An instrument calibrated in an environment at temperature of 20 degree centigrade and the following output readings Y are obtained for input values X .

| Input (x) | Output (y) |
|---------------|----------------|
| 13.1 | 5 |
| 26.2 | 10 |
| 39.3 | 15 |
| 52.4 | 20 |
| 65.5 | 25 |
| 78.6 | 30 |

Determine the measurement sensitivity, expressed as the ratio y/x . 7

- (d) A second order control system of transfer function

$$\frac{X_0}{X_i} = \frac{0.4}{D^2 + D + 1}$$

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- has been subjected to unit amplitude sinusoidal input signal which has frequency of 0.5 Hz. Establish an expression for the steady state response of the system and determine the corresponding output amplitude output frequency and phase lag. 7
2. (a) Give any two reasons for the popularity of bourden tube element for pressure measurement. 7
- (b) Describe the constructional features of a ring balance manometer and show how the deflection of the pointer is related to pressure. 7
- (c) A well type U-tube manometer using a liquid of specific gravity 0.8 has a well of 50 mm diameter and a tube of 20 mm bore. If a scale correctly graduated in mm is used and the datum is 0 mm. Calculate the reading on scale when a pressure difference of 80 mm of mercury is applied. Calculate the percentage error in reading and the actual error in N/m^2 . Assume pressure on account of 1 mm of mercury = 133 N/m^2 . 7
- (d) What is load cell and how is it made for use in industry? 7

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3. (a) Name the materials of which thermister are made and its range for measuring the temperature. 2
- (b) Discuss the working of thermocouples for temperature measurement? What is CJC? How it is achieved? What are compensating cables? Why and how are they used. 7
- (c) Describe the working of bimetallic thermometer with the help of a neat sketch. 7
- (d) A sensor measures temperature linearly with a static transfer function of $33 \text{ mV}/^\circ\text{C}$ and has a 1.5 s time constant find the output 65 s after the input changes from 20 to 40 . Find the error in temperature this represents. 7
4. (a) What is Reynold number? 2
- (b) Compare and contrast the use of venturimeter, flow nozzle and orifice meter as primary element for flow measurement. 7
- (c) Explain the principal of operation of hot wire anemometer. 7
- (d) Calculate the flow rate of water through a 10 cm pipe with an orifice of 5 cm as restriction. The orifice

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- is arranged for flang taps and mercury manometer reads 30 cm. Hg at 27°C . The temperature of flow water is 33°C . Assume $\mu = 0.00052 \text{ kg/ms}$
 $h_m = 0.30 \text{ m}$, $E = 1$, $\rho_f = 992 \text{ kg/m}^3$,
 $\rho_m = 13490 \text{ kg/m}^3$. 7
5. (a) A sensor has a transfer function of $5 \text{ mV}/^\circ\text{C}$. find the required voltage resolution of the signal conditioning if a temperature resolution of 0.2°C is required. 2
- (b) Draw the block diagram of simple process control loop and identify each loop. 7
- (c) Compare electrical, pneumatic and hydraulic actuators. 7
- (d) Define the three parts of final control element operation. 7