# MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

**Paper Code : TT-301**

## INSTRUMENTATION AND CONTROL

*Time Allotted* : 3 Hours | *Full Marks* : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

### GROUP – A

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) One Torr is defined as

a) one mm Hg b) one inch Hg

c) one atmosphere d) one kilo pascal.

ii) Gauge pressure is

a) absolute pressure

b) absolute pressure – atmospheric pressure

c) atmospheric pressure

d) atmospheric pressure – absolute pressure.

iii) Thermocouple is based on

a) Seebeck effect b) Peltier effect

c) Beer-Lambert law d) Thomson effect.

iv) Which of the following is used in non-contact type temperature measurement ?

a) Thermocouple b) Radiation pyrometer

c) RTD d) Thermistor.

v) Mason's gain formula is used to find

a) open loop transfer function

b) closed loop transfer function

c) both (a) & (b)

d) none of these.

vi) A rise in ambient temperature and resultant rise in LVDT temperature results in

a) increase in primary impedance

b) reduction in primary current

c) both (a) & (b)

d) none of these.

vii) Lambert's law is expressed as $T =$

a) $I / I_0$ b) $I_0 / I$

c) $I * I_0$ d) $I^2 * 100$.

viii) A transducer converts

a) electrical energy to any other form of energy

b) electrical energy to light energy

c) mechanical displacement into electrical signal

d) electrical energy to mechanical energy.

ix) Which of the following is an example of an active transducer ?

a) Potentiometer b) LVDT

c) Thermocouple d) Encoder.

x) If movable core of a LVDT is near secondary winding ($S_2$), then which secondary winding ($S_1$ or $S_2$) will undergoes less flux linkage, while no A.C. is connected to the primary winding (P) ?

a) $S_1$ b) $S_2$

c) $P$ d) None of these.

xi) Which of the following is used to measure humidity ?

a) Hydrometer b) U-tube manometer

c) Rotameter d) Hygrometer.

xii) Density applies to a substance in

a) solid state b) liquid state

c) gas state d) all of these.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following. 3 × 5 = 15

2. State the differences between open-loop and closed-loop control system. State the Laplace transform of $e^{-at}$, $\sin^{\omega t}$. What do you mean by pole and zero of a transfer function ? 2 + 1 + 2

3. What are the advantages of electrical transducer ? What do you mean by active and passive transducers ? Give examples. 2 + 3

4. Why non-contact type temperature measurement is needed ? Explain a non-contact type temperature measurement technique with the help of proper schematic diagram. 1 + 4

5. Differentiate between PI and PID controller. Define Transfer function. 3 + 2

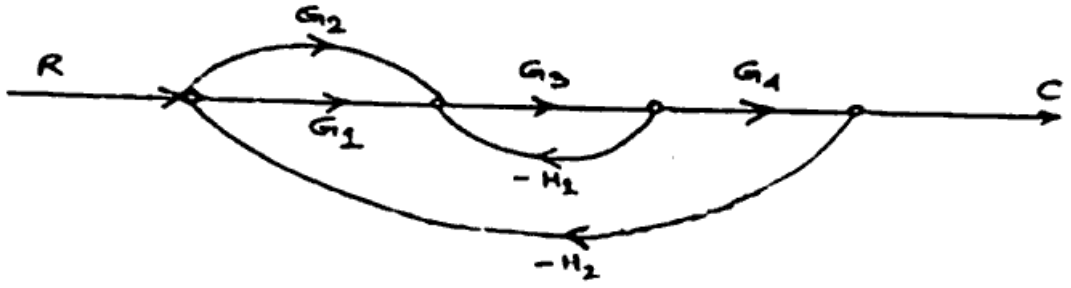
6. With a neat sketch explain working principle of Gow-Mac densitometer. What is Triple point ? 4 + 1

## GROUP – C

### ( Long Answer Type Questions )

Answer any *three* of the following. 3 × 15 = 45

7. Using Mason's gain formula determine the ratio C/R for the system shown below :




For the transfer function $G(s) = \dfrac{(s^2+4)(1+2\cdot5s)}{(s^2+3)(1+0\cdot5s)}$.

Plot poles and zeros in *s*-plane and determine the value of transfer function at $s = 2$.

What do you mean by dead time ? What do you mean by controller ? 7 + 4 + 2 + 2

8. What is RTD and how is it used ? Draw a bridge circuit for temperature measurement by RTD. Write down the working principle of LVDT with the help of a neat sketch. Explain with a neat sketch diagram, how capacitive pressure transducers works ? 2 + 3 + 5 + 5

9. What do you mean by Gauge pressure, Absolute pressure, Vacuum or Differential pressure, Static and Velocity pressure ? Explain with a neat sketch diagram how Magnetic drag cup or Eddy current tachometer works in case of torque measurement.

Prove that $\frac{C(s)}{R(s)} = \frac{G(s)}{1 + G(s) * H(s)}$. 5 + 5 + 5

10. a) Explain any type of thickness measurement technique with the help of necessary diagram.

b) The output of an LVDT is connected to a 5V voltmeter through an amplifier of amplification factor 250. The voltmeter scale has 100 divisions and the scale can be read to 1/5th of a division. An output of 2 mV appears across the terminals of the LVDT when the core is displaced through a distance of 0·5 mm. Calculate (i) sensitivity of the LVDT, (ii) that of whole set-up and (iii) the resolution of the instrument in mm.

5 + (4 + 2 + 4)

11. Write short notes on any *three* of the following : 3 × 5

a) Hygrometer

b) 7-Segment display

c) Optical pyrometer

d) PID controller

e) DAS

f) Cathode Ray Tube.