Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech/(FT-OLD)/SEM-6/ET-601/2013

2013

PROCESS 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) A thermistor exhibits

a) only a negative change of resistance with increase in temperature

b) only a positive change of resistance with increase in temperature

c) either a negative or positive change of resistance with increase in temperature depending upon the type of material used

d) none of these.

ii) Capacitive hygrometer for moisture measurement consists of

a) aluminium rod b) iron rod

c) copper rod d) none of these.

iii) Which of the following temperature sensors has excellent linear characteristics ?

a) RTD b) Thermocouple

c) Radiation pyrometer d) Silicon-based I.C chip.

iv) Thermocouple is

a) active transducer

b) passive transducer

c) active or passive transducer

d) none of these.

v) The difference between gauge and absolute pressure is

a) vacuum b) 0·433 psia

c) atmospheric pressure d) None of these.

vi) A strain gauge has a

a) piezoelectric effect b) piezoinductive effect

c) piezocapacitive effect d) none of these.

vii) Human system is

a) a multi-variable feedback control system

b) an open loop control system

c) a single-variable control system

d) a complex control system.

viii) The advantage(s) of Laplace transform is (are)

a) it gives total solution more systematically

b) it gives solution in frequency domain only

c) initial conditions are incorporated in the very first step

d) none of these.

ix) The type of a transfer function denotes

a) the number of zeros at origin

b) the number of poles at origin

c) the number of zeros at infinity

d) the number of infinite poles.

x) If the gain K of the system increases, the steady-state error of the system

a) decreases

b) increases

c) may increase or decrease

d) remains unaltered.

xi) If some pole of a system lies on the imaginary axis, the system is

a) absolutely stable b) conditionally stable

c) marginally stable d) unstable.

xii) If the gain (K) of a system becomes zero, the roots will

a) move always from zeros

b) move away from the poles

c) coincide with the zeros

d) coincide with the poles.

xiii) For type 2 system the steady-state error due to ramp input is equal to

a) infinity b) finite

c) zero d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. For a certain thermistor, β = 3140 K and the resistance at 27 °C is known to be 1050 Ω. Thermistor is used for temperature measurement and the resistance measured is as 2330 Ω. Find the measured temperature.

3. Explain the working principle of McLeod Gauge.

4. The $G(s)$ and $H(s)$ are forward path transfer function and feedback transfer function respectively. Show that the overall transfer function of a closed loop is given by $\frac{G(s)}{1 + G(s)\,H(s)}$.

5. The forward path transfer function of a unity feedback control system is given by $\frac{2}{s(s+3)}$.

   Obtain an expression for unit step response of the system.

6. Determine $f(t)$ for a system whose $F(s) = \frac{s+3}{s+(s+1)^2\,(s+2)}$.

GROUP – C

(Long Answer Type Questions)

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

7. a) Explain the working principle of an electromagnetic flow-meter.

   b) State the operational aspects of instrument system.

   c) Briefly discuss the different types of controller and state their merits and demerits. 6 + 4 + 5

8. a) Explain the working principle of Pirani gauge for low pressure measurement.

   b) Write a note on Infared moisture meter.

   c) Explain the working principle of radiation pyrometer.

   5 + 5 + 5

9. Sketch the root locus of the unity feedback control system whose open loop transfer function is given by $G(s) = \frac{K}{s\,(s+2)\,(s+5)}$. 10

   From the root locus find the following : 5 × 1

   (i) No. of branches

   (ii) Breakaway point

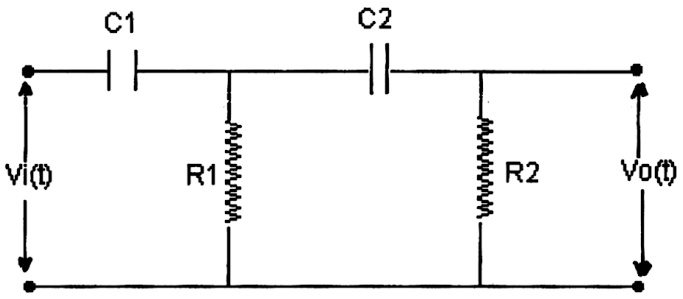
   (iii) Centroid

(iv) The frequency at which the root locus crosses the imaginary axis and the corresponding value of K.

(v) Angle of asymptotes.

10. a) Using Routh-Hurwitz criterion determine the relation between K and T so that unity feedback control system whose open-loop transfer function given below is stable. $G(s) = \dfrac{K}{s\,[\,s\,(s+10)+T\,]}$.

b) Determine transfer function $\dfrac{V_0(s)}{V_i(s)}$ of the figure shown below.



c) What do you mean by closed loop control system ? Discuss the advantages and disadvantages of closed loop control system. 5 + 5 + (2 + 3)

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

a) Thermocouple

b) Load cell

c) PID Controller

d) Transfer Function

e) Standard test signals.