



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(FT)/SEM-6/ET-601/2012

2012

PROCESS INSTRUMENTATION & 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 × 1 = 10

- i) Bimetallic strips made of two different materials bend during a rise in temperature account of
- a) differences in coefficient of linear expansion
 - b) differences in the elastic properties
 - c) differences in the thermal conductivities
 - d) none of these.

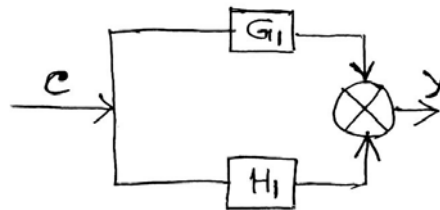


- ii) Optical pyrometer is used to measure
 - a) light intensity
 - b) low temperatures
 - c) high temperatures
 - d) light intensity and high temperatures.
- iii) Which gauge measures pressure by sensing thermal conductivity of a gas ?
 - a) Pirani gauge
 - b) Diaphragm gauge
 - c) McLeod gauge
 - d) None of these.
- iv) In an electromagnetic flow meter, the induced voltage is proportional to
 - a) flow rate
 - b) square root of flow rate
 - c) square of flow rate
 - d) logarithm of flow rate.
- v) Pirani gauge is used for
 - a) low pressure measurement
 - b) medium pressure measurement
 - c) high pressure measurement
 - d) any of these.



vi) The overall transfer function of the system is

- a) $G_1 H_1$ b) $G_1 + H_1$
- c) $G_1 - H_1$ d) $\frac{G_1}{(1 + G_1 H_1)}$



vii) In stochastic control system the response is

- a) predictable
- b) predictable & repeatable
- c) repeatable
- d) unpredictable & not repeatable.

viii) The characteristics equation of a system is

$$S^2 + 2S + 2 = 0 . \text{ The system is}$$

- a) critically damped b) under damped
- c) over damped d) none of these.



- ix) The Routh-Hurwitz criterion gives
- a) relative stability b) absolute stability
 - c) transfer function d) none of these.
- x) Root locus always starts from
- a) breakaway points
 - b) origin
 - c) poles of the open loop transfer function
 - d) zeros of the open loop transfer function.
- xi) When a first order system is activated by a step input, steady state error is
- a) zero b) 1
 - c) ∞ d) ψ .
- xii) A system has a single pole at origin. Its impulse response will be
- a) constant b) ramp
 - c) decaying exponential d) oscillatory.

GROUP – B

(Short Answer Type Questions)

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

2. Explain the working principle of Pirani gauge for low pressure measurement. What are the advantages of temperature measurement by using this thermometer ?

3 + 2



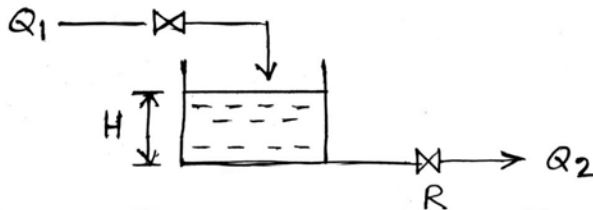
3. Write short notes on any *two* of the following : $2 \times 2\frac{1}{2}$
- Standard test signals
 - Infrared moisture meter
 - Advantages & disadvantages of RTD.
4. Write down the initial value and final value theorem. Give four comparison of open loop and closed loop control system. $2 + 3$
5. Apply *R-H* criterion to determine the stability of the system whose characteristics equation is given by
- $$s^5 + 2s^4 + 24s^3 + 48s^2 - 25s - 50 = 0$$
6. Explain briefly the working principle of radiation pyrometer.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Determine the transfer function of the following liquid level system :



- Describe a method for measurement of vacuum pressure using McLeod gauge.
- Give a comparison between 'thermistors' and 'RTDs'.

$5 + 5 + 5$



8. Sketch the root locus of the unity feedback control system whose open loop transfer function is given by

$$G(s) = \frac{K}{s(s+2)(s+5)}$$

From the root locus find

- 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. 5×3
9. a) Explain the working principle of an electromagnetic flowmeter.
- b) What are the operational aspects of instrument system ?
- c) Discuss the different types of controller and their merits and demerits. $6 + 4 + 5$
10. a) A unity feedback control system has an open loop transfer function

$$G(s) = \frac{K}{s(s^2 + 4s + 13)}$$

Sketch the root locus plot of the system and comments on stability.



- b) What is Transient and Steady State Response? Define the following time domain indices of a control system :

i) Rise time

ii) Settling time

iii) Peak overshoot.

10 + 2 + 3

11. a) What are the basic components of feedback control loop ?

- b) What are the differences between P , PI and PID controller ?

- c) What is the load cell ? What are the advantages and disadvantages of load cell ?

- d) Show that the sensitivity of a system w.r.t. the feedback is unity.

3 + 4 + 2 + 3 + 3

=====