Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (CT)/SEM-7/CHE(CT)-701/2012-13

2012

INSTRUMENTATION AND PROCESS 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 the following : $10 \times 1 = 10$

   i) If the impulse response of a system is te^{-t}, the transfer function of the system is

   a) $\frac{1}{s^2}$ b) $\frac{1}{s(s+1)}$

   c) $\frac{1}{(s+1)^2}$ d) $\frac{1}{s^2(s+1)}$.

ii) The damping factor of the system with transfer function $\frac{100}{2s^2+3s+8}$ is

a) $\frac{3}{10}$ b) $\frac{1}{4}$

c) $\frac{3}{4}$ d) $\frac{3}{20}$.

iii) Increase in order of a system may

a) improve accuracy b) increase instablity

c) both (a) and (b) d) none of these.

iv) In process control analysis, deviation parameters are used to

a) make the system linear

b) make the initial conditions zero

c) both (a) & (b)

d) none of these.

v) The settling time of the response of a second order underdamped system depends on

a) damping factor b) period of oscillation

c) both (a) and (b) d) none of these.

vi) Each instrument must possess following number of elements :

a) two b) three

c) four d) none of these.

vii) Which of the following is not a pressure gauge ?

a) Bourdon gauge b) McLeod gauge

c) Vibrometer d) Manometer.

viii) The output from a piezoelectric crystal is

a) displacement b) light

c) voltage d) force.

ix) The counterterm for accuracy is

a) static error b) repeatability

c) drift d) sensitivity.

x) The input to a thermocouple is

a) displacement b) electrical potential

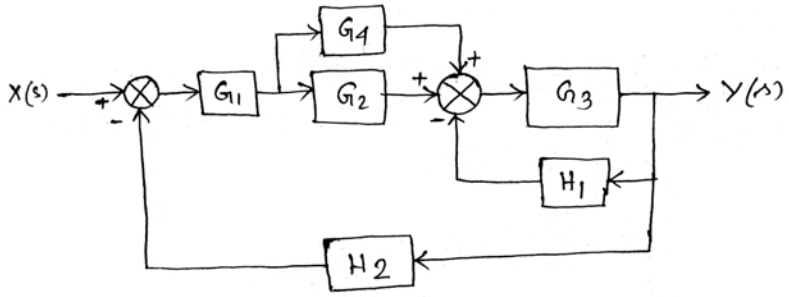
c) light intensity d) temperature.

GROUP – B

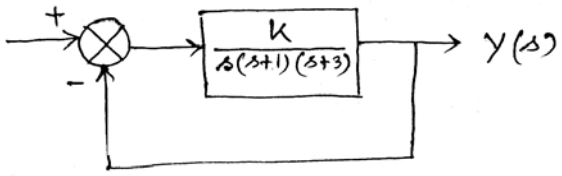
(Short Answer Type Questions)

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

2. Reduce the following block diagram and find $\frac{Y(s)}{X(s)}$.



3. Find the range of k for stability of the following system.



4. A unit step change is introduced into a system having the transfer function $\frac{Y(s)}{X(s)} = \frac{10}{s^2 + s + 4}$.

   Determine (i) Rise time, (ii) Percent overshoot.

5. Describe how dynamic characteristics are explained in the light of standard inputs.

GROUP – C

(Long Answer Type Questions)

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

6. A thermometer having first order dynamics with a time constant of 1 min is placed in a temperature bath at 110°F. After it reaches steady state, it is suddenly placed in a bath at 100°F at t = 0 and left there for 1 min, after which it is immediately returned to the bath at 110°F.

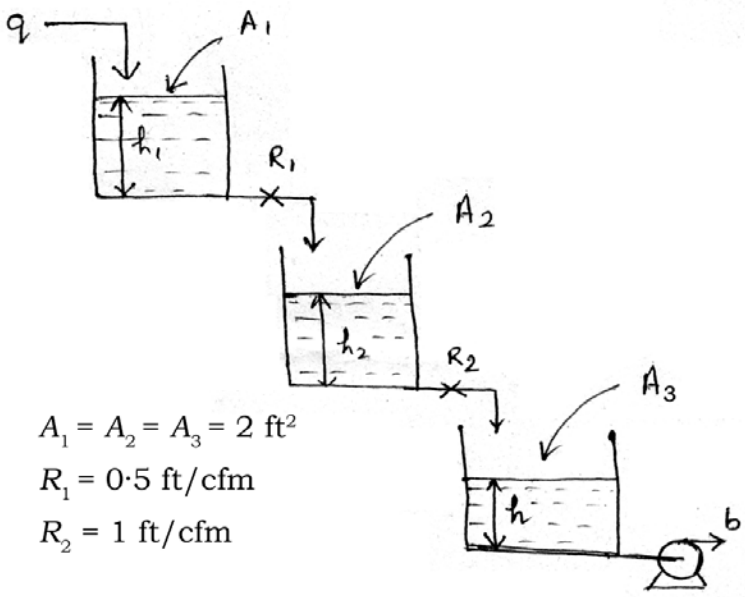
   a) Draw a sketch showing the variation of the surrounding temperature for the thermometer.

   b) Find the expression for thermometer reading.

   c) Draw a sketch showing thermometer reading as a function of time.

   d) Calculate thermometer readings at t = 0·5 min and t = 2 min. 2 + 6 + 3 + 4

7. The three tank system shown in figure is in the steady state with q = 2 cfm and h = 1·5 ft. Suddenly 10 ft^3 liquid is added to the first tank at t = 0



Find

a) initial liquid level in each tank

b) transfer function between q and h

c) variation in h, the actual level in the last tank

d) final liquid level (actual) in the last tank. 3 + 4 + 6 + 2

8. The mixing process shown in figure-1 is a steady state with the input concentration x of 1 lb/ft^3. If x varies with time as shown in figure-2,

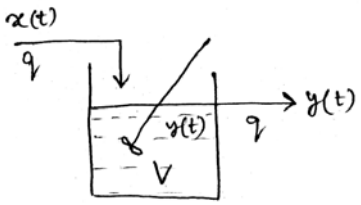


Figure 1

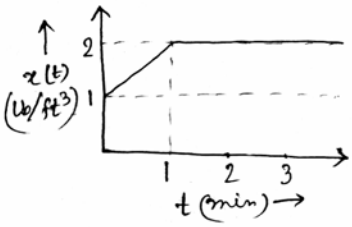


Figure 2

a) derive the transfer function of the system

b) find $x(s)$

c) find initial and final output concentration (actual)

d) find the expression for actual output concentration, $y(t)$ 4 + 3 + 4 + 4

9. How the Gas Purge technique is used to measure the liquid level in a tank ? Describe the operation of an optical pyrometer with necessary sketch. 7 + 8

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