Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PCCH 4304

Sixth Semester Examination – 2013

PROCESS DYNAMICS AND CONTROL

BRANCH : CHEMICAL

QUESTION CODE : A163

Full Marks – 70

Time : 3 Hours

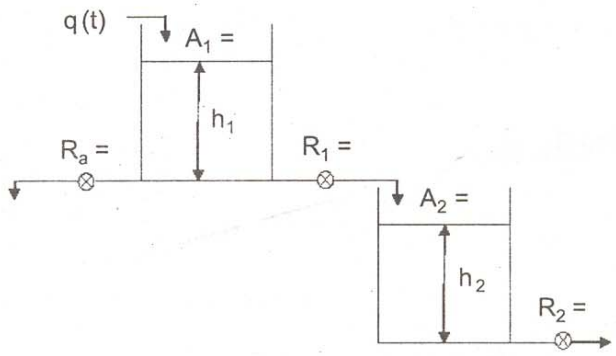
*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10
   (a) Write the objectives of a controller.
   (b) Write the principal characteristics of a first order system.
   (c) A P-controller of gain 5 is used to control two non-interacting processes having time constants 1 and 2 sec. Find out the offset if a step input of magnitude 3 is introduced in the set point.
   (d) Draw the dynamic behavior of the PI, PD, and PID controller.
   (e) Differentiate between corner and crossover frequency.
   (f) Write the disadvantages of Routh-Hurwitz method.
   (g) Define integral square of error.
   (h) What is process reaction curve ? Mention its use.
   (i) Write the advantages of feed forward controller.
   (j) Find out the sampling period for a first order system with time constant 3 sec and delay time 5 sec.
2. (a) A thermometer having first order dynamics with 1 m diameter bulb and 6 mm in length of bulb. Specific heat of mercury is 1.38 kJ/Kg.^{0}C. The heat transfer coefficient is 300 W/m^2.^{0}C. Calculate the time required to attain 90 % of the applied magnitude of step change in temperature. 8
   (b) Define time constant. 2

P.T.O.

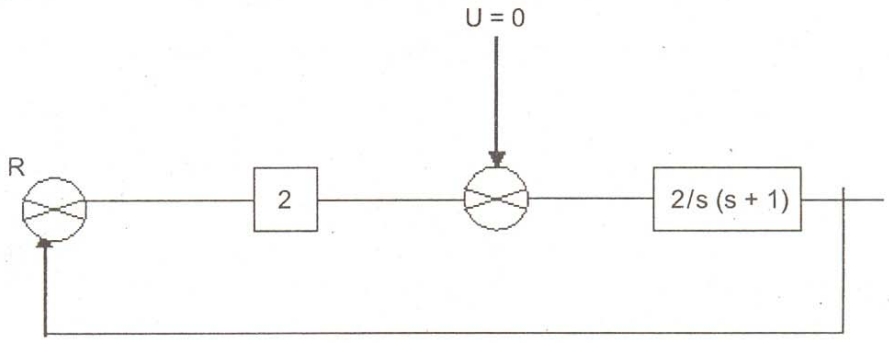
3. (a) Find the transfer function $H_1(s) / Q(s)$ and $H_2(s) / Q(s)$ for the figure. 7



(b) What is a pure capacitance system ? 3

4. A thermometer which was initially at a temperature of 80^0F is suddenly placed in a bath at 250°F. After 150 seconds the thermometer reaches 95 % of its ultimate response. If the same thermometer is placed in a bath at 400°F how long it will take to have the same response. Assume first order dynamics. 10

5.



If a step input of unity magnitude is introduced in the set point then find the following : 10

(a) C/R

(b) Ultimate Response

(c) Offset

(d) C(0.5)

(e) Whether it is a servo or regulatory problem ?

6. (a) The open loop transfer function of a control system is given as :

$$G(S) = K_C (0.5s + 1)/s(s + 1)(s + 0.5)$$

Draw the Root Locus diagram of the control system. Determine the gain of the controller K_C for which the system becomes just unstable. 4

(b) A control system having transfer function is expressed as :

$G(S) = 5/1.8s2 + 3s + 5$

The control system is subjected to a step change of magnitude 5.

Calculate : 6

(i) the value of Y(t) at t = 1 min,

(ii) the offset and ultimate response, and

(iii) overshoot, decay ratio, and maximum value of Y(t).

7. (a) Sketch the asymptotic bode diagram of control system having open loop transfer function given as : 5

$$G_{(s)} = \frac{k_c(5s+1)}{(2s+1)(s+1)}$$

(b) With the help of process reaction curve method find the controller setting of PI controller if the open loop transfer function is given as $\frac{1}{(s+1)^3}$. Solve this problem analytically. 5

8. Write short notes on any *two* : 5×2

(a) Ratio Controller

(b) Pulse transfer function of a first order system

(c) Sampling of continuous signal

(d) Ziegler-Nichol's method.
