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

Total number of printed pages – 3

B. Tech

PCCH 4304

Sixth Semester Regular / Back Examination – 2015

PROCESS DYNAMICS AND CONTROL

BRANCH : CHEM

QUESTION CODE : J 132

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.
Assume suitable notations and any missing data wherever necessary.

1. Answer the following questions : 2×10

   (a) What is a rate controller ?

   (b) What type of controller is used in the iron box ? Justify your answer.

   (c) A PD controller of gain 5 and derivative time constant of 3 sec 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 a second order instrument with step input for under damped, critically damped, and over damped system.

   (e) Differentiate between servo and regulatory problem.

   (f) Write the disadvantages of root locus method.

   (g) What are Bode stability criteria in terms of gain margin ?

   (h) Define physically realizable and non-realizable controllers.

   (i) What is a smith predictor ?

   (j) Find out the sampling period for a first order system with time constant 3 sec and delay time 5 sec.

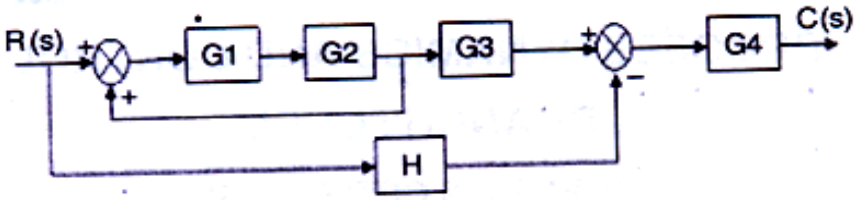
2. (a) Consider a stirred tank reactor. The reaction is A → B, which is a 1st order reaction. Assuming constant density and constant volume, derive the transfer function relating the concentration in the reactor to the feed stream

P.T.O.

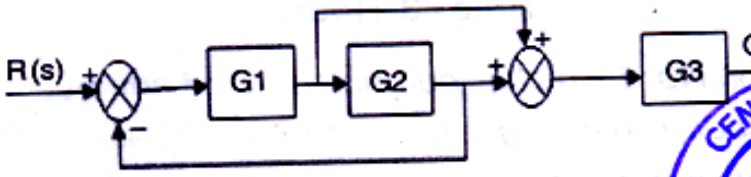
concentration. Prepare a block diagram for the reactor in order to control the concentration of the reactor using feed forward controller. 8

(b) How a feed forward controller differs from feedback controller. 2

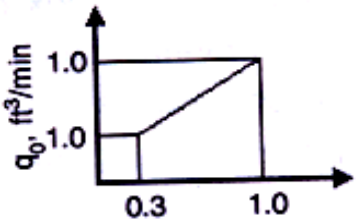
3. (a) Determine the overall transfer function C(s)/R(S) for the following system. 5



(b) Determine the overall transfer function C(s)/R(S) for the following system. 5



4. A tank having a cross-sectional area of 2 ft^2 is operating at steady state with an inlet flow rate of 2.0 cfm. The flow head characteristics are shown in the following figure.



(a) Find the transfer function H(s)/Q(s). 5

(b) If the flow to the tank increases from 2.0 to 2.2 cfm according to a step change, calculate the level h two minutes after the change occurs. 5

5. A step change of magnitude 4 is introduced into a system having the transfer function $G(s) = \dfrac{10}{S^2 + 1.6S + 4}$. 2×5

Determine :

(a) Overshoot,

(b) Rise Time,

(c) Maximum Value of Y(t),

(d) Ultimate value of Y(t), and

(e) Period of oscillation.

6. (a) Find the pulse transfer function for $G_p = \frac{5}{2S+1} e^{-2S}$ with sampling period of 1.5 second. 6

(b) Find the inverse Z-transformation by long division method. 4

$$y(Z) = \frac{Z^{-1}}{1 - 4Z^{-1} + 3Z^{-2}}.$$

7. (a) Sketch the asymptotic bode diagram of control system having open loop transfer function given as $G_{(s)} = \frac{k_c S(5S+1)}{(2S+1)(S+1)}$. 5

(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 $\frac{1}{(s+1)(S+2)}$. Solve this problem analytically. 5

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

(a) Cascade controller

(b) Design of a sample data controller

(c) Root-locus method

(d) Dead time compensation.