



RN-7327

B. E. - IV (Sem. VII) (Chemical) Examination
May / June - 2010
Process Control

Time : 3 Hours]

[Total Marks :

Instructions :

(1)

नीचे दर्शाविए निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="checkbox"/> B. E. - 4 (Sem. 7) (Chemical)	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="checkbox"/> Process Control	<input type="text"/>
Subject Code No. : <input type="text"/> 7 <input type="text"/> 3 <input type="text"/> 2 <input type="text"/> 7	<input type="text"/>
Section No. (1, 2,.....) : <input type="text"/> 1&2	
Student's Signature	

- (2) Answer each section separately.
(3) Write in a neat handwriting.
(4) Assume suitable data wherever necessary.

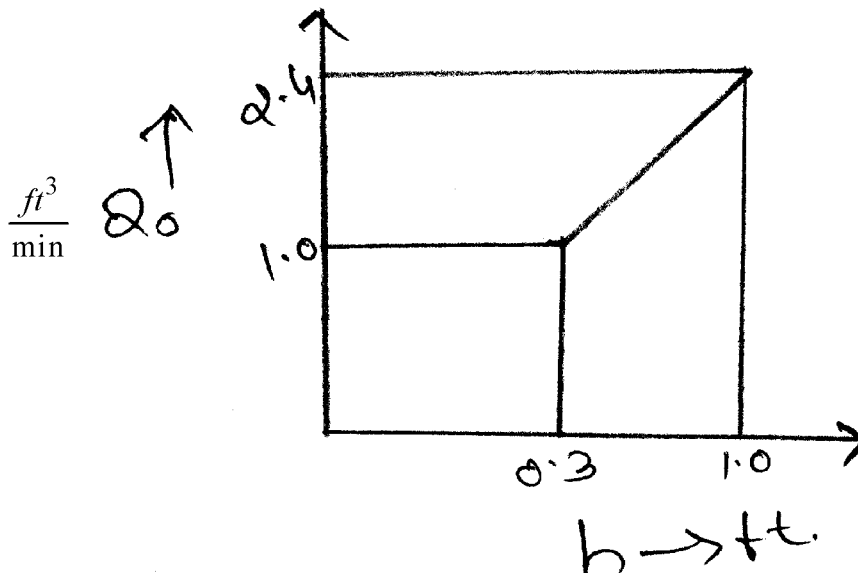
SECTION - I

- 1 (a) Answer the following questions : 10
- (i) The general transfer function of a first order system is _____.
- (ii) The time constant of a system unit of _____.
- (iii) Ordinary mercury in a glass thermometer without any covering an air gap is an example of _____ system.
- (iv) Time lag of a first order system is _____.
- (v) The Laplace transformation of a function f(t) is defined to be f(s) according to which equation.
- (vi) What is the response of a first order system.

$$G(s) = \frac{1}{\tau s + 1} \text{ to an unit step change in}$$

input is given.

- (vii) In the steady-state response of a first order system to a sinusoidal forcing function, what is the ratio of output amplitude to input amplitude?
- (viii) Phase angle (ϕ) of the sinusoidal response of a first order system is _____.
- (ix) Time constant of mercury in glass thermometer if without covering air gap is _____.
- (x) The steady state response of a first order system to a sinusoidal function $a \sin \omega t$ is _____.
- (b) The tank having a cross sectional area of 2 ft^2 is operating at s to s with inlet flow rate of 1.0 cfm . The flow head characteristics are shown in figure :



- (i) Find the transfer function $H(S)/G(S)$.
- (ii) If the flow to the tank increase from 2.0 to 2.2 cfm . according to a step change. Calculate the level h after two min. the change occurred.

2 Attempt any two :

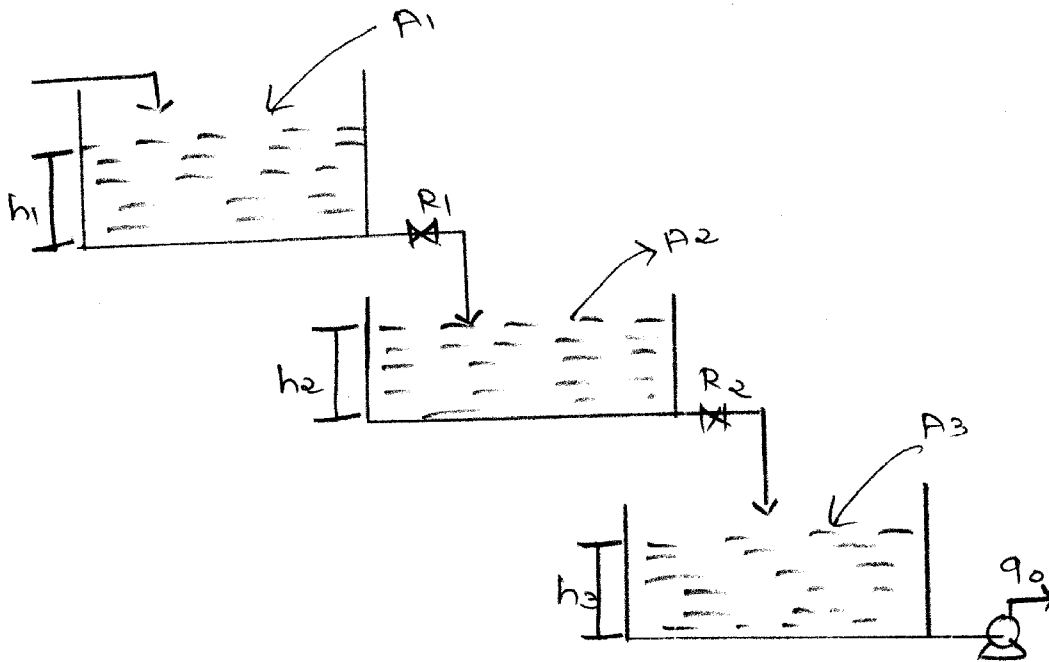
16

(a) (i) What is linearization? Develop the transfer function for the liquid level system with non-linear resistance which has been linearised.

(ii) Find the value of laplace transform $\frac{dx}{dt} + x = 1, x(0) = 0$

(iii) Determine the transfer function $\frac{H(s)}{Q(s)}$ for the liquid

level system shown in figure. Respectively R_1 and R_2 are the linear flow rate from tank 3 is maintained at constant. q_0 By means of pump to the flow rate of tank 3 is independent of head h . The tank are non-interacting.



3 Attempt any **two** :

16

- (i) A thermometer having a time constant of 0.1 min. is at a steady state temp. of 90°F. At time $t = 0$ the thermometer is placed in a temp. bath maintained at 100°F. Determine the time needed for the thermometer to read 98°.
- (ii) Derive the equation for liquid level first order system

$$\frac{H(s)}{Q(s)} = \frac{R}{\tau s + 1}$$

- (iii) Derive the equation of the response of a first order system to a step forcing function and for an impulse forcing function.

SECTION - II

4 (a) Answer the following :

2×5=10

- (i) Define Decay ratio.
- (ii) Draw a block diagram of a simple control system.
- (iii) Draw a response curve of a PI controller to a unit step change in error with the equation of transfer function.
- (iv) What type of response can be observed with proportional (P) and derivative (D) control?
- (v) Name different stability criterion method for the control system.
- (b) Explain the terms used to describe an underdamped system.

5 Answer any two :

2×8=16

- (a) The two tank liquid level system shown in figure (a) is operating at steady state when a step change is made in the flow rate to tank 1. The transient response is critically damped and it takes 1.0 min for the change in level of the second tank to reach 50% of the total change.

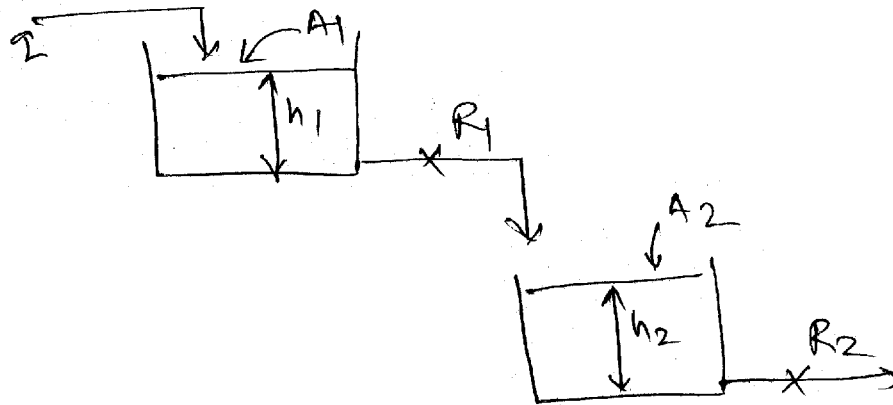


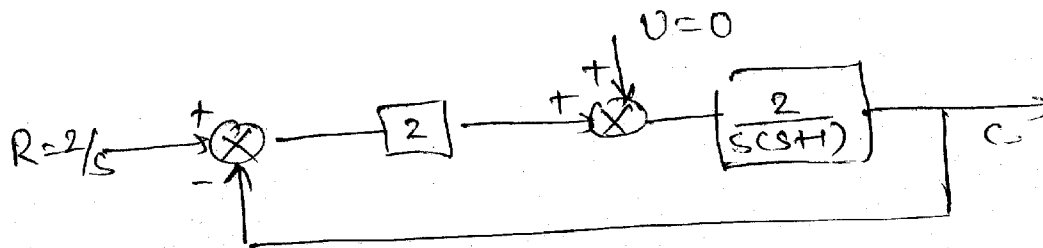
Fig. (a)

If the ratio of the cross sectional areas of the tanks

is $A_1/A_2 = 2$, calculate the ratio R_1/R_2 . Calculate the

time constant for each tank. How long does it take for the change in level of the first time to reach 90% of the total change?

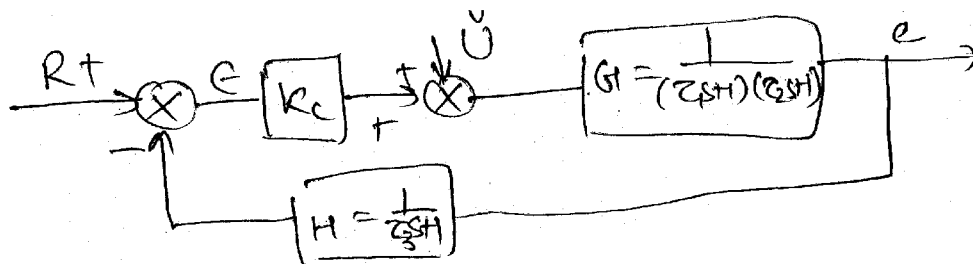
- (b) Derive the transfer function of PI and PD. Explain the response of above two control system.
- (c) For the control system shown in figure (c) determine
- $C(s)/R(s)$
 - $C(\infty)$
 - Offset
 - $C(0.5)$, assume $\tau = 1$
 - Whether the closed loop response is oscillatory.



6 Answer the following :

14

- (a) (i) Using $\tau_1 = 1, \tau_2 = 1/2, \tau_3 = 1/3$ determine the values of K_c for which the control system shown in figure (d) is stable.



- (ii) For the value of K_c for which the system is on the threshold of instability, determine the roots of the characteristic equation with the help of Bode stability criterion.

OR

- (a) Answer the following : 14
- (i) Explain Bode diagrams for Ist order system. 5
 - (ii) Explain cascade control for distillation column. 5
 - (iii) Write down the relative advantages and 4
disadvantages of feed forward and feedback
control system.
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