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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9014 Roll No.

**B.Tech.**

FIFTH SEMESTER EXAMINATION, 2005-2006

# PROCESS DYNAMICS AND CONTROL

*Time : 3 Hours* *Total Marks : 100*

**Note :** *(i) Attempt ALL questions.*

*(ii) All questions carry equal marks.*

*(iii) Be precise in your answer.*

1. Attempt *any four* parts of the following :

(a) What do you understand by translation of a function ? What is its application in study of dynamic behaviour of a system ?

(b) Find the inverse laplace transform of following :

$f(s) = 1/(s^3 + 3s^2 + 7s + 5)$

(c) Differentiate between a negative feed back and positive feedback control system. Discuss their advantages and limitations with suitable examples.

(d) How a mechanical displacement signal can be converted into a pneumatic signal ? Discuss with the help of a suitable example.

(e) What are the various types of roots a characteristic equation of a control system may have ? How do they help in understanding the behaviour of the system ?

(f) 'The measured value of a variable can be different than the actual value of variable being measured in a dynamic system'. Justify the above statement with suitable examples.

2. Attempt *any two* parts of the following :

(a) How the response of a first order system depend upon time constant of the system for different kind of inputs ? Show with appropriate examples.

(b) Show that a thickwalled thermometer behaves as a second order system overdamped.

(c) A thermometer having first order dynamics with a time constant of two minutes is at 80° C. It is placed in a water bath at 100° C for 3 minutes and then again placed in a water bath at 80° C. Obtain an expression for thermometer reading with respect to time and find temperature shown by the thermometer at (a) 2 minutes and (b) 4 minutes.

3. Attempt *any two* parts of the following :

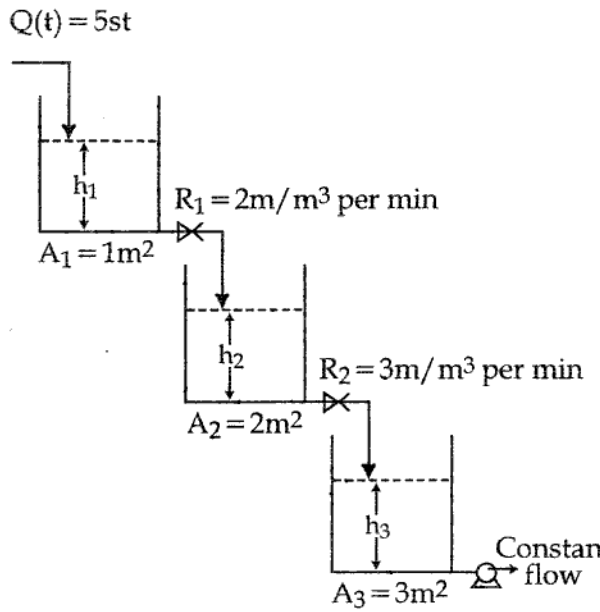
(a) Discuss the response of a second order system for a sinusoidal input. Show as to how amplitude ratio and lag vary with frequency.

(b) What do you understand by the terms overshoot and decay ratio as applied to response of a second order system. Obtain the expressions for them in term of $\tau$ and $\xi$ ?

(c) In the liquid level system shown below, the deviation in flowrate to tank 1 is an impulse function of magnitude 5. Determine the expressions for :

(i) $H_1(s)$, $H_2(s)$ and $H_3(s)$

(ii) $H(t)$, $H_2(t)$ and $H_3(t)$




4. Attempt ***any two*** parts of the following :

(a) What are the various final control elements used in a closed loop control system ? Describe the working of one of them in detail.

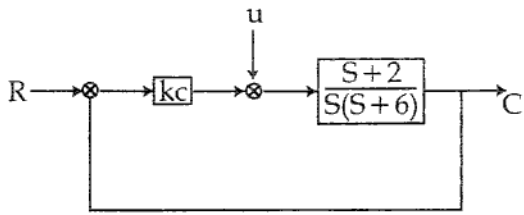
(b) Show that by the addition of integral mode in a proportional controller, the offset is completely removed. Also enlist the limitations / disadvantages of PI controller.

(c) For the control system shown below, find :

(i) C(S) / u(S)

(ii) the value of $K_c$ for which the closed loop response has a $\xi = 3.0$

(iii) the offset for a unit step change in u for $K_c = 4$




5. Attempt *any two* parts of the following :

(a) Discuss the Routh's Test for testing the stability of a control system. What other informations are obtained by Routh's theorem about the control system ?

(b) Draw the root locus for a control system having following characteristic equation.

$$1 + \frac{k(4S+1)}{S(S+1)(S+2)} = 0$$

(c) Show that by subtituting jw for S in open loop transfer function of a control system the magnitude and angle of complex number so obtained, correspond to amplitude ratio and lag.

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