M.Tech. First Semester (Chemical Engineering) (CBS)

13003 : Process Control : 1 CE 3

P. Pages : 2 | AV - 3385

Time : Three Hours | Max. Marks : 80

Notes :
1. Answer six questions.
2. Questions No. 1 is compulsory.
3. Assume suitable data wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.

1. Plot the root locus diagram for the following system and also determine which values of k make the system stable. **15**

$$G(s) = \frac{K}{(s+1)(s+2)(s+3)}.$$

2. The overall transfer function of the control system is given as, **13**

$$G(s) = \frac{16}{1.5s^2 + 2.4s + 6}.$$

A step change of magnitude 6 is introduced into the system.

1) Overshoot.
2) Period of oscillation
3) Natural period of oscillation.
4) Rise time.
5) Ultimate value of response.
6) Maximum value of response.

3. The open loop transfer function a control system is givens – **13**

$$G(s) = \frac{K_C}{s(0.1s+1)(10s+1)}$$

Sketch the Asymptotic Bode diagram of control system. Determine the value of K_C for which the control system is stable.

4. In a mixing tank the feed rate of solution is $1.5\ m^3/min$ and the volume at tank is $1.5\ m^3$. The steady state concentration is $0.03k\ mol/m^3$. The inlet concentration of the feed is increased to $0.08k\ mol/m^3$. After 0.55min, the concentration of the feed is decreased to $0.035k\ mol/m^3$. Calculate the outlet concentration of the solution for $t = 0.1\,min$, $t = 0.55\,min$ and $t = 1.5\,min$. **13**

5. An aqueous solution in a tank is heated by a coil. The density and the specific heat of solution is $1000kg/m^3$ & $4kJ/kg°C$ respectively. The feed rate is $1.5\ m^3/min$ & the time constant of the tank is 90 sec. The power supplied to the heating coil is varied sinusoidally between 500 to 600 kW with a 38 Sec/cycle period of oscillation. The steady state temperature is 60°C calculate. **13**

i) The temperature of the solution at t = 30 sec.
ii) Amplitude ratio.
iii) Phase lag.

6.		Explain the control strategies of distillation column for pressure control and product quality control used in chemical process plant.	**13**
7.		Discuss the term.	
		1) Phase margin.	**4**
		2) Gain margin.	**4**
		3) Ziegler-Nichols (Z-N) controller settings.	**5**
8.	a)	Explain inferential control with advantages & disadvantages.	**8**
	b)	Describe the design criteria of controllers.	**5**
9.	a)	Obtain an analytical expression for a unit impulse response of a control system whose transfer function is as – $G(s) = \frac{Y(s)}{X(s)} = \frac{3}{s^2 + 4s + 3}$.	**4**
	b)	Discuss Adaptive control with applications.	**9**
10.	a)	Explain Distributed control system. (DCS) and mention the application of DCS in chemical process plant.	**7**
	b)	Discuss the term supervisory control with its significance in control system.	**6**

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