

CHEMICAL PLANT UTILITIES

FINAL EXAM

Total No. of Questions : 12
[Time : 3 Hours]

[Total No. of Printed Pages : 3]
[Max. Marks : 100]

Instructions:

- (1) Answer any three questions from each section I and II.*
 - (2) Answers to the two sections should be written in separate answer-books.*
 - (3) Neat diagrams must be drawn wherever necessary.*
 - (4) Black figures to the right indicate full marks.*
 - (5) Assume suitable data, if necessary.*
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SECTION-I

- Q.1 (a) Derive transfer function of single tank liquid level system. Draw a suitable sketch. [8]
- (b) What are the design elements of control system? Explain with examples. [8]

OR

- Q2. (a) A mercury bulb thermometer showing a steady state temperature of 25°C is suddenly immersed into a hot bath at 120°C. If the time constant of thermometer is 8 sec. find:
- I. Thermometer reading after 8 sec
 - II. Time required to read 90°C on thermometer
 - III. Time required for 75% response. [8]
- (b) Discuss the incentives for chemical process control [8]
- Q3. (a) Discuss the characteristics of underdamped response and plot the graph of overshoot and decay versus damping factor ξ [9]
- (b) Derive the transfer function of two tank interacting system. [9]

OR

Q4. (a) Define P, I and D controller and derive their transfer function. Discuss their open loop and closed loop response with diagram. [9]

(b) Consider a second order system with following transfer function [9]

$$G(s) = \frac{Y(s)}{X(s)} = \frac{1}{S^2 + S + 1}$$

Introduce a step change of magnitude 1 into the system and find

- i. Percent overshoot
- ii. Decay ration
- iii. Ultimate value of Y (t)
- iv. Rise time

Q5. (a) Sketch the root locus for the following transfer function [10]

$$G(s) = \frac{K}{S^2(S^2 + 2S + 2)}$$

(b) Using Routh-Hurwitz criteria. Check the stability of system described by following equation. [6]

$$S^3 + 6S^2 + 11S + 6 = 0$$

OR

Q6. Define controller turning and discuss the following turning methods. [16]

- 1) Cohen Coon technique
- 2) Time Integral performance criteria
- 3) One-quarter decay ration

SECTION - II

Q7. (a) Sketch the Bode plot [9]

$$G(s) = \frac{1}{(2S + 1)(5S + 1)}$$

(b) Derive the response of general First order system to Sinusoidal input. Define amplitude and phase lag. [9]

OR

Q8. (a) Explain Gain Margin and Phase margin with a neat sketch [4]

(b) Sketch the Bode Plot for PI controller [8]

(c) Sketch the Nyquist Plot for PD controller [6]

Q9. (a) Explain Ratio Control with a neat sketch. [8]

(b) Explain with a neat sketch Inverse Response system [8]

OR

Q10. (a) Explain the control instrumentation of cascade control for a jacketed CSTR [8]

(b) Draw a neat sketch and explain [8]

1) Feed-back control action

2) Feed-forward control action.

Q11. (a) Explain the reconstruction of continuous time signals from discrete time signal by using hold element. [8]

(b) Write a note on PLC and SCADA system [8]

OR

Q12. (a) Explain in detail the role of digital computer in process control. [8]

(b) What is Plant Wide control? Explain with a suitable example. [8]