



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

1. The open loop transfer function of the control system is given as 15

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

sketch the root locus diagram of the system.

2. The open loop transfer function of a control system is given as 13

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

sketch the asymptotic Bode diagram for the control system.

3. An aqueous solution in a tank is heated by a coil. the density and the specific heat of solution are 1000 kg/m^3 and $4 \text{ kJ/kg } ^\circ\text{C}$ respectively. The steady state temperature of the tank content is 30°C . The feed rate is $1.5 \text{ m}^3/\text{min}$ and the volume in of the tank is 1.5 m^3 . The heating coil is subjected to a step change of 500 kW . Calculate the outlet temperature of the solution for $t = 0.5 \text{ min}$, $t = 1 \text{ min}$, $t = 3.5 \text{ min}$, $t = 5 \text{ min}$ & $t = 6 \text{ min}$. 13

4. A thermometer is observed to exhibit the first order dynamics is having time constant of 6 second is placed in a bath. The bath is subjected to the impulse change of magnitude 3°C . The steady state temperature indicated by the thermometer is 30°C calculate the temperature indicated by the thermometer at $t = 3 \text{ sec}$, $t = 6 \text{ sec}$ & $t = 18 \text{ sec}$. 13

5. Discuss the Z-transforms for - 13

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|------------------------|-------------------------|
| 1) Impulse function | 2) Step function |
| 3) Ramp function | 4) Exponential function |
| 5) Sinusoidal function | 6) Transportation Lag |

6. Discuss the various control strategies in shell & Tube heat exchanger for by passing the process fluid and controlling medium flow rate. 13

7. Explain the term Direct Digital Control (DDC) and elaborate the application of DDC system for chemical reacts? 13

8. a) Define and explain cascade control with function of primary and secondary controllers. 5
- b) Discuss the feed forward control with its advantages and disadvantages. Also give the application of feed forward control of CSTR. 8

9. a) Find the inverse Z transform of $\frac{3z}{(z-1)(z-0.4)}$ by method of partial fraction. 6
- b) Discuss Ziegler - Nichols (Z-N) controller setting. 7
10. a) What is the highest value of K for which the open loop pulse transfer function given below, is stable? 9
- $$\frac{K}{(z-0.25)(z-0.5)}$$
- b) Define 4
- i) Phase Margin. ii) Gain Margin.
