Roll No. | | | | | | | | | | |

# ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

## B.E / B. Tech (Full Time) END SEMESTER EXAMINATIONS – NOV / DEC 2024

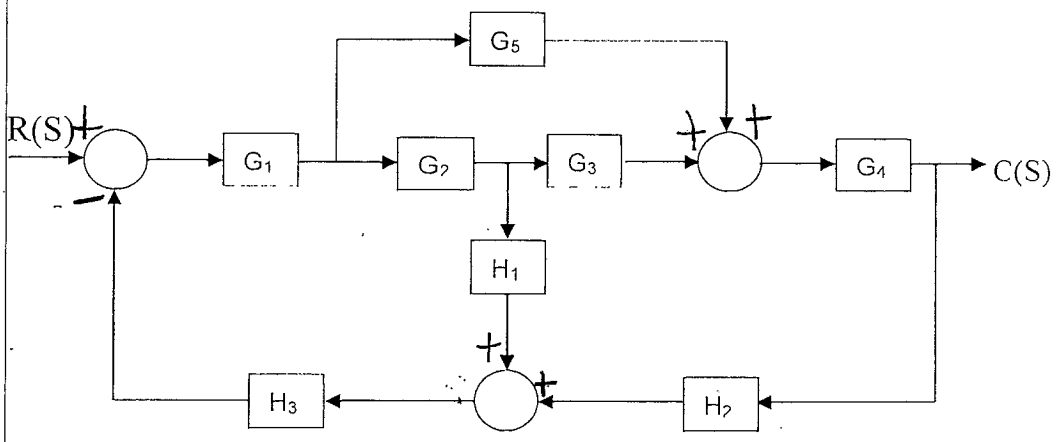
**V Semester**
**EE8501 & CONTROL SYSTEMS**
**(Regulation –2012)**

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

## PART- A (10 x 2 = 20 Marks)

| Q.No | Questions | Marks |
|---|---|---|
| 1. | What are the advantages and disadvantages of block diagram representations? | 2 |
| 2. | List the energy dissipating elements in mechanical and electrical systems. | 2 |
| 3. | What is the nature of the response with different types of damping? | 2 |
| 4. | How do you determine the point of intersection of the root locus with imaginary axis and the critical value of K? | 2 |
| 5. | What is constant N circle? | 2 |
| 6. | Calculate resonant peak and resonant frequency if $\zeta$ =0.7 and $\omega_n$=2 rad/sec. | 2 |
| 7. | Determine the stability of the system whose A matrix is $=\begin{bmatrix}1 & 4\\ 5 & 1\end{bmatrix}$ | 2 |
| 8. | State the observability theorem. | 2 |
| 9. | List the advantages and disadvantages of P and D controller. | 2 |
| 10. | Draw electrical lead compensator network. | 2 |

## PART- B (5 x 16 = 80 Marks)

| Q.No | Questions | Marks |
|---|---|---|
| 11. | Using block diagram reduction technique find the transfer function given below. Also check the answer with signal flow graph.   | 8+8 |
| 12. | a) i. A unity feedback control system has an open loop transfer function $G(s)=\frac{5}{s(s+9)}$ Find the rise time, percentage overshoot, peak time, and settling time for a unit step input. | 8 |

| | | |
|---|---|---|
| | ii The open loop transfer function of a closed loop system with unity feedback is $G(s) = \frac{K}{(s+2)(s+1)(s+3)(s^2+6s+25)}$ By applying the Routh criterion, discuss the stability of the closed loop system as a function of K. Determine the values of K which will cause sustained oscillations in the closed loop system. What are corresponding oscillation frequencies? | 8 |
| | OR | |
| | b) The open loop transfer function of a control system is given by $G(s)H(s) = \frac{K(s+7)}{s(s+8)(s^2+6s+13)}$. Sketch the root locus. | 16 |
| 13. | a) Draw the Bode plot for a control system having transfer function $G(s)\,H(s) = \frac{500(s+2)(s+20)}{s^3(s+100)(s+200)}$ Determine gain margin and phase margin using the Bode plot. | 16 |
| | OR | |
| | b) Draw the polar plot for the following transfer function $G(s) = \frac{1}{s^2(1+s)(1+2s)(1+3s)}$ Determine the gain margin and phase margin of the system. | 16 |
| 14. | a) i) Calculate the eigenvalues and eigenvectors of the system whose matrix given $A=\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -5 & -4 \end{bmatrix}$ | 8 |
| | ii) Derive the transfer function corresponding to the following state model $\dot{x}=\begin{bmatrix} 0 & 3 & 8 \\ -1 & -1 & 6 \\ 1 & 2 & 4 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}+\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}u$ $y=\begin{bmatrix} 0 & 2 & 1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$ | 8 |
| | OR | |
| | b) i) Test the controllability and observability of the system described by $\dot{x}=Ax+Bu,\ y=cx$ $A=\begin{bmatrix} 8 & 6 & 2 \\ 7 & 3 & 4 \\ -6 & -11 & -6 \end{bmatrix}$, $B=\begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$ and $C=[1 \quad 5 \quad 1]$ | 10 |
| | ii) Write the properties of the state transition matrix along with the proof. | 6 |
| 15. | a) Consider a Type I unity feedback system with an open loop transfer function $G(s)= k/s(s+1)$. Design a suitable compensator with the following specifications $k_v=10$, phase margin $=45°$. | 16 |
| | OR | |
| | b) i) Discuss in detail about Z-N (first and second method) tuning for PID controller. | 6 |
| | ii) What are compensators? What is a lag-lead compensator? Write the design procedure of the lag-lead compensator. | 10 |