C **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: R9401

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Open Elective

R21UEC901- LINEAR CONTROL ENGINEERING

(Regulations R2021)

(Use of Polar graph and Semi log graph can be allowed)

Duration: Three hours Maximum: 100 Marks

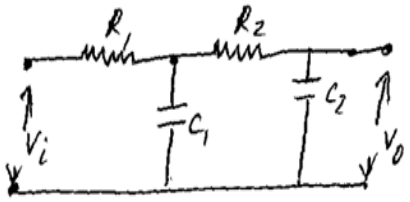
Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1.	State Mason's gain formula.	CO1-U
2.	Write the rule for eliminating negative feedback loop.	CO1-U
3.	Illustrate how a control system is classified depending on the value of damping ratio?	CO1-U
4.	A unity feedback system has a open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$. Determine the steady state error for unit step input.	CO2-App
5.	The closed loop transfer function of a second order system is . $\frac{C(s)}{R(s)} = \frac{10}{s^2 + 6s + 10}$ What is the type and order of the system?	CO3 - App
6.	What is phase and gain crossover Frequency?	CO1 - U
7.	What is root locus?	CO1 - U
8.	Brief the computation process of angle of departure.	CO1 - U
9.	Describe State and State Variable.	CO1 - U
10	The transfer function of a system is given by $\frac{Y(s)}{U(s)} = \frac{10}{4s^2 + 2s + 1}$. Determine the differential equation governing the systems.	CO3 - App

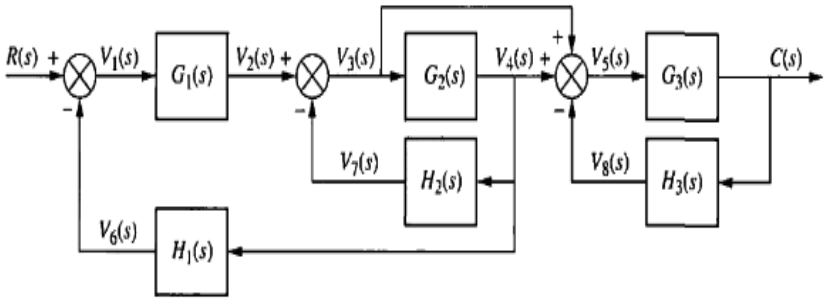
PART – C (5 x 16= 80 Marks)

11. (a) Estimate the Transfer function of the electrical network shown in the figure. CO2-App (16)



Or

(b) For the block diagram shown below, inspect the output C/R. CO2-App (16)



12. (a) A unity feedback control system has an open loop transfer function $G(S) = \frac{10}{s(s+2)}$. Find the rise time, percentage over shoot, peak time and settling time for a step input of 12 units. CO2-App (16)

Or

(b) An unit feedback system has $G(s) = \frac{1}{s(1+2s)}$. The input to the system is described by $r(t)=2+4t+6t^2+2t^3$. Determine the generalized error coefficients and express the steady state error as a function of time. CO2-App (16)

13. (a) Sketch the polar plot and find the gain and phase margin of a control system has $G(S) = \frac{1}{S^2(S+1)(1+2S)}$ with unity feedback . CO3-App (16)

Or

(b) For the given transfer function CO3-App (16)

$$G(s) = \frac{5(1+2s)}{(1+4s)(1+0.25s)}$$

Estimate the value of phase and gain margin using bode plot.

14. (a) A unity feedback control system has an open loop transfer function, $G(s) = \frac{K}{(s+2)(s+4)(s^2+6s+25)}$. By applying the routh criterion, discuss the stability of the closed-loop system as a function of k. Determine the value of K which will cause sustained oscillations in the closed –loop system. What are the corresponding oscillating frequencies? CO4- Ana (16)

Or

(b) Label the Root Locus of the system whose open loop transfer function is $G(S) = \frac{K}{S(S+2)(S+4)}$. Determine the value of K for damping ratio equal to 0.5. Analyze the stability condition of the system. CO4- Ana (16)

15. (a) The State model matrices of a system are given below CO5- Ana (16)

$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ and $C = [\,3 \quad 4 \quad 1\,]$. Generalize the Observability of the system and thereby analyze the stability of the system.

Or

(b) Determine the state variable representation of the system whose transfer function is given as $\frac{Y(s}{U(s)} = \frac{10}{s^3+4s^2+2s+1}$ and analyze the controllability and Observability of the system. CO5- Ana (16)