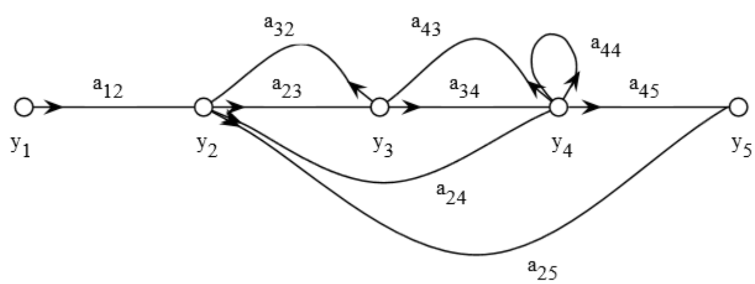
Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2025

Course: Control system engineering **Semester: VI**
Program: B.Tech. Electronics & Communication engineering **Time : 03 hrs.**
Course Code: ECEG 3048 **Max. Marks: 100**
No. of pages: 3

S. No.		Marks	CO
	SECTION A **(5Qx4M=20Marks)**		
Q 1	A system has an open-loop transfer function G(s) = K / [s^2(s+3)]. Determine the system type and find the steady-state error for a unit step input.	**4**	**CO1**
Q 2	The Laplace transform of impulse response of a control system gives the transfer function of that function. Do you agree with the sentence? Justify your answer.	**4**	**CO2**
Q 3	The principle of homogeneity and additivity is applied to which types of systems and why?	**4**	**CO2**
Q 4	Describe the step, ramp, impulse, and sinusoidal input signals, including their mathematical expressions and time-domain characteristics.	**4**	**CO2**
Q 5	Define the gain margin and phase margin.	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Consider the characteristic equation of a control system given as: $s^4 + 4s^3 + 6s^2 + 4s + 2 = 0$ a) Apply the Routh-Hurwitz criterion to determine the stability of the system. Clearly state the stability conditions and calculate how many poles lie in the right-half of the s-plane. b) Suppose a proportional gain K is added to the forward path of the control system, resulting in the open-loop transfer function: $G(s) = K / (s^4 + 4s^3 + 6s^2 + 4s + 2)$ With unity feedback, derive the new characteristic equation of the closed-loop system in terms of K. c) Use the Routh-Hurwitz criterion to determine the range of values of K for which the closed-loop system is stable. Also, find the value of K at which the system becomes marginally stable.	**10**	**CO2**
Q 7	The maximum overshoot and settling time for a control system whose overall transfer function is standard second order system are 10% and 4	**10**	**CO3**

	second respectively. The input being a unit step function. Determine the value of ζ and ω_n in order to satisfy these requirements.		
Q 8	The transfer function of a feedback control system is given below: $$G(s) = \frac{K}{s(s+1)(s+3)} \text{ and } H(s) = 1$$ Sketch the root locus plot as K is varied from 0 to inf and determine (Draw on answer sheet paper) (a) The value of K such the system becomes unstable (b) The value of K such that the system is critically damped. **OR** The overall transfer function of a unity feedback control system is given by $$G(s) = \frac{10}{s^2 + 6s + 10}$$ (a) Find the error constants K_p, K_v and K_a. (b) Determine the steady state error if the input is $r(t) = 1 + t + t^2$	**10**	**CO3**
Q 9	Signal flow graph is given for a system in figure, find the transfer function using Mason's gain formula.  	**10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q 10	A unity feedback system has the open-loop transfer function: G(s) = 100 / [s(s + 2)(s + 5)] a) Sketch the asymptotic Bode plot (magnitude and phase) for the open-loop transfer function. Indicate the break frequencies clearly. b) Determine the gain margin and phase margin from the Bode plot. c) Comment on the stability of the closed-loop system using Bode stability criteria. d) Suggest how the system gain can be modified to improve phase margin without significantly affecting system bandwidth.	**20**	**CO4**
Q 11	The open-loop transfer function of a system is given by: $G(s)H(s) = 50(s + 4) / [s^2 + 6s + 25]$	**20**	**CO4**

	a) Derive the Nyquist plot for the open-loop transfer function. Show the steps involved in plotting the system's response and explain how the poles and zeros affect the plot. b) Use the Nyquist criterion to analyze the stability of the closed-loop system. Determine whether the system is stable, unstable, or marginally stable based on the Nyquist plot. c) Calculate the gain margin and phase margin from the Nyquist plot. Explain the significance of these margins in terms of system performance and stability. **OR** For the block diagram given in the figure the output Y(s) = M(s)R(s)+M_w(s)W(s). find the transfer function M(s) and M_w(s).