Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III EXAMINATION – WINTER 2025

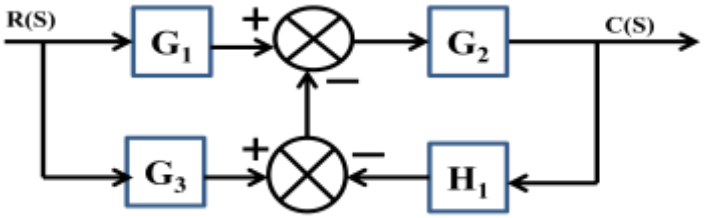
Subject Code:3130905 **Date:22-12-2025**

Subject Name: Control System Theory

Time:10:30 AM TO 01:00 PM **Total Marks:70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Explain properties of Laplace transform.	**03**
	(b)	Explain transfer function and State advantages and dis advantages.	**04**
	(c)	Solve the block diagram to find transfer function of the system shown in figure. 	**07**
Q.2	**(a)**	Explain with example the first order system.	**03**
	(b)	Write note on steady state error and error constants	**04**
	(c)	Solve the expression of response of first order system for a unit step input and unit impulse. Is it possible to get expression of response for impulse input if the expression is available for unit step input? If yes why?	**07**
		OR	
	(c)	Determine Stability using R-H criteria $$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$	**07**
Q.3	**(a)**	State the nyquist stability criteria. Why the nyquist criteria are called a frequency response method?	**03**
	(b)	Define the gain margin and phase margin when gain and phase crossover frequency is zero and infinity in the bode plot?	**04**
	(c)	The open loop transfer function of a unity feedback system is given by G(s)=k/ $s(Ts+1)$ where k and T are constants. By what factor should the amplifier gain be reduced so that the peak overshoot of the system is reduced from 75% to 25% ?	**07**
		OR	

Q.3	**(a)**	Simplify the significance of PI control.	**03**
	(b)	Distinguish state variable approach verses the classical approach of transfer function for the analysis of control systems.	**04**
	(c)	Define the following terms- 1-Gain Margin 2-Phase Margin 3-Bandwidth 4-Resonant Frequency 5-Gain Crossover Frequency 6-Frequency Domain 7-Resonant Peak	**07**
Q.4	**(a)**	List out types of compensation and explain any one.	**03**
	(b)	Explain bode plot of Lag-Lead compensator	**04**
	(c)	Explain in detail the steps to design a lag compensator.	**07**
		OR	
Q.4	**(a)**	Explain the advantages of bode plot.	**03**
	(b)	Explain how do you determine the gain crossover frequency and phase crossover frequency from the bode plot?	**04**
	(c)	Explain step by step procedure to obtain Root locus design.	**07**
Q.5	**(a)**	Explain polar plots with a sketch of a simple example	**03**
	(b)	Write the applications of frequency response methods.	**04**
	(c)	Assuming zero initial conditions derive the transfer function for the system described by the standard state variable model.	**07**
		OR	
Q.5	**(a)**	Explain following terms. 1) State variable 2) State trajectory 3) State vector	**03**
	(b)	Decide that How stability can be ensured from Routh Table?	**04**
	(c)	Investigate Controllability of the system $X(t) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -4 & -2 \end{bmatrix} X(t) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$ $c(t) = [5 \quad 1 \quad 0]x(t)$	**07**

****