Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–IV (NEW) EXAMINATION – WINTER 2024

Subject Code:3141708 Date:21-11-2024

Subject Name: Control Theory

Time:02:30 PM TO 05:00 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)**	Give the difference between positive feedback system and negative feedback system.	**03**
	(b)	Explain automatic tank level control system with neat sketch.	**04**
	(c)	Derive the transfer function of armature controlled DC motor.	**07**
Q.2	**(a)**	Explain the rules for block diagram reduction techniques with neat sketches.	**03**
	(b)	Give the importance of state model representation.	**04**
	(c)	Find stability of characteristic equation $\mathbf{s^5+s^4+2s^3+2s^2+3s+5 = 0}$ using Routh stability criteria.	**07**
		OR	
	(c)	Explain Hurwitz stability criteria and find the stability of second order system $\mathbf{S^4+8S^3+18S^2+16S+5 = 0}$.	**07**
Q.3	**(a)**	Give the properties of the state transition matrix.	**03**
	(b)	Explain correlation between transient response and frequency response.	**04**
	(c)	The open loop transfer function of a feedback system is given by $\mathbf{G(S)H(S) = K / [S (S+4) (S^2+4S+20)]}$. Design root locus and comment on stability.	**07**
		OR	
Q.3	**(a)**	Derive the resolvent matrix for unforced system having state equation $\dot{x}=Ax$.	**03**
	(b)	State and explain the steps to plot Nyquist stability criteria plot and mention the condition for stability of the control system.	**04**
	(c)	Construct the bode plot for the transfer function $\mathbf{G(s) = [64 (s+2) / s (s+0.5) (s^2+3.2s+64)]}$	**07**
Q.4	**(a)**	Explain regenerative feedback.	**03**
	(b)	Explain speed control governor system with neat sketch.	**04**
	(c)	Explain Force Voltage and Force Current analogy with suitable example.	**07**
		OR	
Q.4	**(a)**	Explain the effect of feedback on bandwidth.	**03**
	(b)	Explain missile launching and guidance system with neat sketch.	**04**
	(c)	Explain Mason's Gain formula for signal flow graph with simple example.	**07**
Q.5	**(a)**	Define: 1.Phase margin 2.Phase crossover frequency 3.Gain margin	**03**
	(b)	Derive steady state errors for Type 0, Type1 & Type 2 systems with unit step, unit ramp and unit parabolic inputs.	**04**
	(c)	Derive the time response of second order system with unit step input.	**07**
		OR	
Q.5	**(a)**	Define: 1.State 2. State equation 3. State trajectory	**03**
	(b)	Enumerate the rules for construction of Root Locus.	**04**
	(c)	Derive the complete solution of linear system state equation $\mathbf{\dot{x}=Ax+Bu}$.	**07**

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