Seat No./Enrollment No.: _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BACHELOR OF ENGINEERING – SEMESTER 5 – EXAMINATION – SUMMER 2026

Subject Code: 3151908 **Date: 21/05/2026**

Subject Name: Control Engineering

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.**

Q.1	**(a)**	Define the terms: a) Control variable b) Plant c) Process	**03**
	(b)	Explain with examples: open loop and close loop control system. Explain with suitable example.	**04**
	(c)	Explain force current analogy with proper example.	**07**
Q.2	**(a)**	Classify the type of control systems and explain time variant system with suitable example.	**03**
	(b)	Explain the analysis of gear train with inertia and friction.	**04**
	(c)	Derive the transfer function of simple liquid level system with interaction.	**07**
		OR	
Q.2	**(c)**	Define thermal resistance and thermal capacitance. Also derive the transfer function of Thermometer placed in water bath as a Thermal system.	**07**
Q.3	**(a)**	Derive Correlation Between Transfer Functions and State-Space Equations.	**03**
	(b)	Define and explain the following terms related to the transfer function of a system. Poles, Zeros, Characteristic equation, order.	**04**
	(c)	Determine the transfer function of system if impulse response of system is $e^{-2t}\sin 5t$	**07**
		OR	
Q.3	**(a)**	Define: State variable, state vector and state space	**03**
	(b)	Enlist Advantage and Disadvantages of state space analysis technique.	**04**
	(c)	What is force voltage analogous system? Which are the analogues quantities according to this method?	**07**
Q.4	**(a)**	Explain the following terms: Delay time, Rise time, Peak time.	**03**
	(b)	Compare Routh's stability criteria and Nyquist stability criteria.	**04**
	(c)	Explain pneumatic force-balance type Proportional controller with neat sketch and state limitations.	**07**
		OR	
Q.4	**(a)**	What is Phase margin and Gain margin? State importance of it.	**03**
	(b)	Define the following terms. Stable systems, Unstable system, Critically stable system	**04**

(c) Consider a closed loop system defined by **07**
$s^4+3s^3+5s^2+7s+K=0$.
Determine the range of K for which the system is stable using Routh-Hurwitz stabiliy criterion.

Q.5 **(a)** Explain when the system is said to be underdamped, overdamped and critically damped for a second order unity feedback control system with step input. **03**

(b) Discuss the effect of adding integral control action to a first order unity feedback proportional control system with step input. **04**

(c) List all the steps to sketch the Bode plot. **07**

OR

Q.5 **(a)** Explain nozzle -flapper amplification in a pneumatic system. **03**

(b) Explain tuning of PID controller in brief. **04**

(c) List all the steps to sketch the Polar plot. **07**

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