

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-IV EXAMINATION – WINTER 2025

Subject Code:3141708

Date:15-11-2025

Subject Name:Control Theory

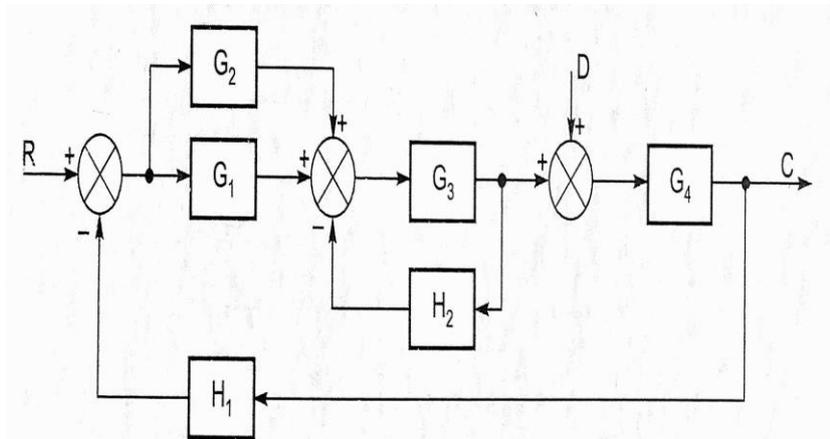
Time:02:30 PM TO 05:00 PM

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) Derive the equation to obtain the transfer function from the state space model.	03
	(b) Explain linearization of nonlinear system with suitable example.	04
	(c) Explain the control system design process in detail.	07
Q.2	(a) Explain the standard test input signals.	03
	(b) Discuss the cost of feedback in the control design process.	04
	(c) The feedback control reduces the system sensitivity to parameters changes. Justify with necessary mathematical arguments.	07
OR		
	(c) Discuss the effects of feedback control on measurement noise attenuation.	07
Q.3	(a) Define state, state vector and state space.	03
	(b) Derive the equation of rise time for second order underdamped control system.	04
	(c) Determine the ratio $\frac{C}{R}$, $\frac{C}{D}$ and the total output of the system given by the block diagram below.	07



OR

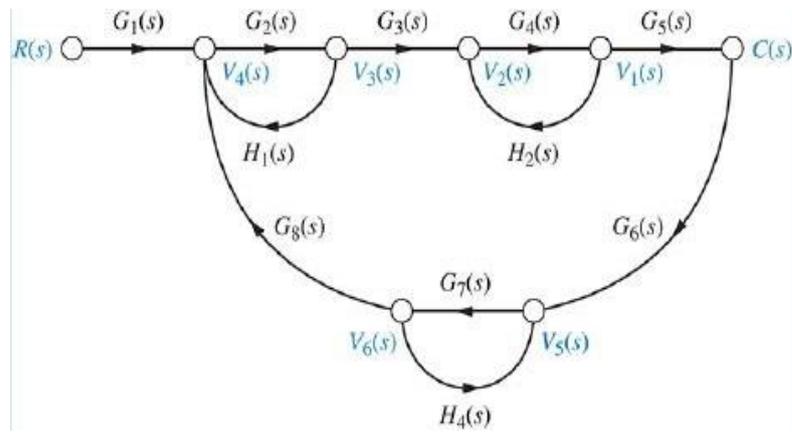
Q.3	(a) Draw the step response of critically damped, overdamped and underdamped systems.	03
	(b) The forward path transfer function of a unity feedback control system is given by	04

$$G(s) = \frac{2}{s(s + 3)}$$

Obtain an expression for unit step response of the system.

(c) Find the transfer function of the signal flow graph given below.

07



Q.4 (a) State the Nyquist stability criteria. 03

(b) Using Routh criterion investigate the stability of a unity feedback control system whose open loop transfer function is given by $G(s) = 2 \frac{e^{-sT}}{s(s+2)}$. 04

Sketch the root locus and determine the stability for the open loop 07

(c) transfer function given by $G(s)H(s) = \frac{K(s+0.1)}{s(s-0.2)(s^2+s+0.6)}$

OR

Q.4 (a) Define following: (1) Gain Margin (ii) Phase Margin (iii) Phase Crossover Frequency 03

(b) Discuss the Nyquist stability criteria for the stability of control systems with time delays. 04

A unit step input is applied to a unity feedback control whose open loop 07

(c) transfer function is given by $G(s) = \frac{K}{s(sT+1)}$. Determine the values of K and T given that maximum overshoot $M_p = 26\%$ and resonant frequency $\omega_r = 8$ rad/sec.

Q.5 (a) Find the impulse response of the unity feedback control system whose open loop transfer function is given by $G(s) = \frac{(4s+1)}{4s^2}$. 03

(b) Give the comparison between transfer function approach and state space approach. 04

Sketch the Bode plot and comment on the stability for the transfer 07

(c) function given by $G(s)H(s) = \frac{2(s+0.25)}{s^2(s+1)(s+0.5)}$.

OR

Q.5 (a) Determine the position and velocity error coefficient for the system given by $G(s) = \frac{100(s+2)(s+40)}{s^3(s^2+4s+200)}$. 03

(b) Determine the dimensions of state matrix, input matrix, output matrix and feedforward matrix for the system having 3 state variables, 2 input variables and 2 output variables. 04

Sketch the Nyquist plot for a unity feedback control system given by 07

(c) $G(s) = \frac{Ks^3}{(s+1)(s+2)}$ and determine the stability condition.
