Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– III(NEW) EXAMINATION – WINTER 2022

Subject Code:3131101   **Date:22-02-2023**
Subject Name:Control Systems
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)**	Compare closed loop and open loop system.	03
	(b)	Discuss Force-Current (F-I) analogous system with analogous quantity.	04
	(c)	Define steady state error and derive the expressions for static error coefficients corresponding to step, ramp and parabolic inputs respectively.	07
Q.2	**(a)**	List properties of the transfer function.	03
	(b)	Discuss unit step response of first order system.	04
	(c)	Draw the Nyquist plot for $G(s) = 1/s(s+1)$ and comment on system stability.	07

OR

	(c)	For the signal flow graph shown in Fig. 1, using Mason's gain formula determine the overall transmission C/R.	07
Q.3	**(a)**	What is polar plot?	03
	(b)	Using Routh's criterion check the stability of a system whose characteristic equation is given by $s^5 + 2s^4 + 2s^3 + 4s^2 + 11s + 10 = 0$	04
	(c)	Obtain the state transition matrix for the state model whose system matrix is given by A=[1 1;0 1].	07

OR

Q.3	**(a)**	Describe in brief about PD controller.	03
	(b)	List advantages of state variable analysis.	04
	(c)	Draw the bode plot for a unity feedback system having,	07

$$G(s) = \frac{100}{s(1+0.5s)(1+0.1s)}$$

Q.4	**(a)**	Discuss following transient response specification: Delay Time, Peak overshoot, Settling Time	03
	(b)	Describe critical rules of block diagram reduction techniques.	04
	(c)	What is Root locus? Sketch the Root locus plot for the unity feedback system having open loop transfer function,	07

$$G(s) = \frac{K}{s(s+3)(s^2+3s+4.5)}$$

OR

Q.4	**(a)**	Define: Gain margin, phase margin, absolute stability	03
	(b)	Describe any four block diagram reduction techniques.	04
	(c)	Discuss steps to design a Lag Compensator using Bode plot method.	07
Q.5	**(a)**	Write a note on PID controller.	03
	(b)	Derive the expression for peak time Tp for a second order control system subjected to a unit step input.	04
	(c)	Write a short note on state space representation of a control system.	07

Q.5 **(a)** Discuss the effect of feedback on sensitivity. 03
   (b) Explain the Lead Compensator with its transfer function. 04
   (c) Derive the state variable equation $\dot{X} = AX + BU$ and $Y = CX + DU$. Also 07
       draw the state diagram

Fig. 1

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