Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2023

Subject Code:3140313 Date:24-01-2024

Subject Name: Control System and Analysis

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)**	The impulse response of a system is e^{-2t}. Find the transfer function.	**03**
	(b)	Explain Force to Voltage analogy for mechanical system.	**04**
	(c)	Explain block diagram of different types of control system with examples.	**07**
Q.2	**(a)**	Find out inverse Laplace transform of the function, $(s) = \frac{(s+3)}{(s+2)(s+4)}$.	**03**
	(b)	Obtain differential equation of mechanical system shown in figure 1 and Draw the electric network using force-voltage analogy.	**04**

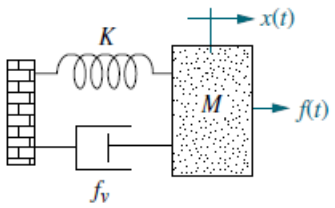

Figure 1.

	(c)	Write Block diagram reduction Rules.	**07**

OR

	(c)	Find the single block equivalent by block diagram reduction technique for the system given in figure 2.	**07**

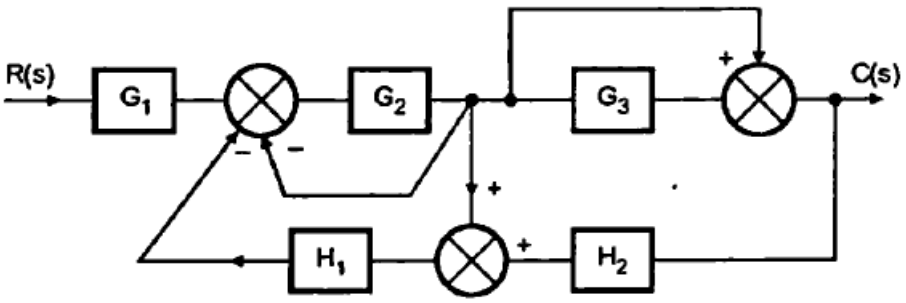

Figure 2.

Q.3	**(a)**	Explain mason's gain formula.	**03**
	(b)	Find out transfer function of the given electrical network in figure 3.	**04**

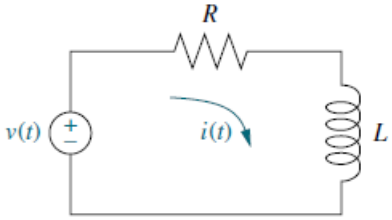

Figure 3.

(c) Find out time domain specification of given system $G(s) = \frac{50}{s^2+5s+25}$. **07**

OR

Q.3 **(a)** Define Settling time, Peak time, Delay time. **03**

(b) Check the stability of the system using Routh's array for the characteristic equation, $S^5 + 2S^4 + 3S^3 + 6S^2 + 5S + 3$. **04**

(c) Using Mason's gain formula, find the gain of the following signal flow graph shown in figure 4. **07**

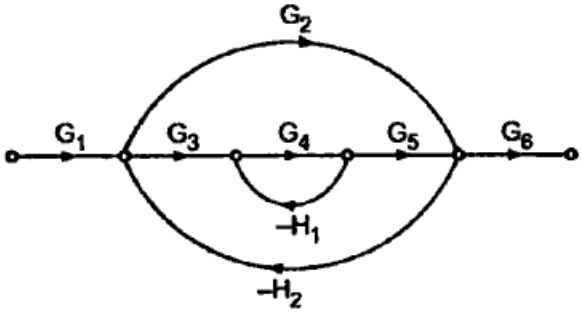

Figure 4.

Q.4 **(a)** Explain Torque to Current Analogy. **03**

(b) Find the range of k for stable operation $G(s) = \frac{k}{s(1+0.4s)(1+0.25s)}$, H(s)=1, by using Routh's array. **04**

(c) Explain Steady state error of Type 0,1, 2 systems for Unit impulse, Unit Step and Unit Ramp function. **07**

OR

Q.4 **(a)** Write comparison of Block diagram reduction and Signal flow Graph methods. **03**

(b) Derive impulse response of first order control system. **04**

(c) Sketch the root locus plot of a unity feedback system with an open loop transfer function of $G(s) = \frac{k}{s(S+4)(S+1)}$. Find the range of k for which system has damped Oscillatory response. **07**

Q.5 **(a)** Define Damping factor, Over damped system and under damped system. **03**

(b) Find the polar plot of $G(s) = \frac{ks^2}{(1+0.2s)(1+0.02s)}$ **04**

(c) For the system having the open loop transfer function $G(s)H(s) = \frac{10}{s(s+1)(s+10)}$. Determine the stability of the system by plotting the bode plot of the system. **07**

OR

Q.5 **(a)** Define stability, Unstable system and Critically stable system. **03**

(b) For the given transfer function, $(s) = \frac{1}{(1+0.2s)(1+0.5s)}$. Decide the stability using Nyquist Plot. **04**

(c) Describe State variables, State vector, State Space. Also Describe State variable Representation of Control system. **07**

****