# GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER- V EXAMINATION-SUMMER 2023
Subject Code: 3151908   **Date: 23/06/2023**
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.**

			Marks
Q.1	**(a)**	What are the advantages and disadvantages of open loop and closed loop systems?	**03**
	(b)	Explain the open-loop operation of traffic signals at a road crossing. How can improved traffic control be achieved by means of a closed-loop scheme?	**04**
	(c)	What is transfer function? Derive the transfer function of spring – mass –damper system.	**07**
Q.2	**(a)**	Draw a general block diagram of Automatic Control System.	**03**
	(b)	i. Differentiate between time varying and time invariant system	**04**
		ii. Differentiate between linear and nonlinear control system	
	(c)	Draw equivalent mechanical and electrical systems to relate force voltage or force current analogy.	**07**

OR

	(c)	Write the differential equations governing the mechanical system. Derive transfer function of $x_1(s)/F(s)$.	**07**

Frictionless
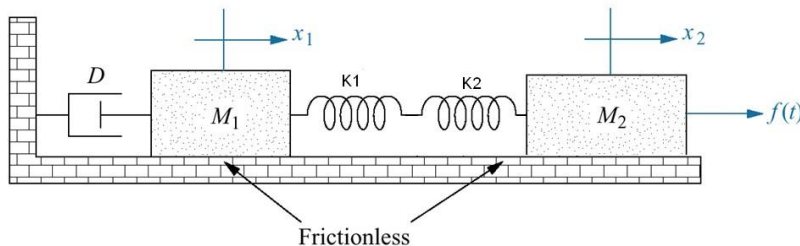
Q.3	**(a)**	Explain following rules for Block Reduction with a sketch (1) Blocks in cascade (2) Eliminating forward loop (3) Eliminating feedback loop	**03**
	(b)	Explain following terms in regard to transient response specification of second order control system using neat sketch. – Delay time t_d – Rise time t_r – Peak time t_p – Maximum overshoot M_p	**04**
	(c)	A system has a characteristic equation, $q(s) = s^6 + 9s^5 + 31.25s^4 + 61.25s^3 + 67.75s^2 + 14.75s + 15 = 0.$ Determine whether the system is stable, marginally stable or unstable using the Routh-Hurwitz criterion.	**07**

OR

Q.3	**(a)**	What do you mean by Stability of Control System?	**03**
	(b)	Explain Proportional hydraulic control system.	**04**

(c) Using the Routh-Hurwitz criterion for simple design problems, consider that the characteristic equation of a closed-loop control system is   **07**

$$s^3 + 3Ks^2 + (K + 2)s + 4 = 0$$

Determine the desired range of K so that the system is stable.

Q.4 (a) Compare between hydraulic and pneumatic control systems.   **03**
(b) State constructional steps for Root Locus method.   **04**
(c) Explain unit step response of first order linear time invariant systems.   **07**

OR

Q.4 (a) Explain various test signals used in control systems.   **03**
(b) Which are different Industrial Controllers? Explain Tuning of PID controllers.   **04**
(c) Sketch the root locus plot of the system with   **07**

$$G(s) = \frac{K}{s(s + 1)(s + 2)} \quad , \quad H(s) = 1$$

Q.5 (a) Describe the working of a force distance type pneumatic proportional controller.   **03**
(b) Define frequency domain specifications with neat sketch.   **04**
(c) Draw the Bode magnitude and phase plot of the following open-loop transfer function and determine gain margin, phase margin and absolute stability?   **07**

$$G(s)H(s) = \frac{1}{s(s + 1)}$$

OR

Q.5 (a) Write about pneumatic power sources.   **03**
(b) What is FRL unit in pneumatic system? State various components used in pneumatic circuit   **04**
(c) Determine the transfer function $C(s)/R(s)$ for the system shown in figure using Mason's gain formula.   **07**