Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(NEW) EXAMINATION – SUMMER 2022

Subject Code:3151908 Date:02/06/2022

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)**	Draw generalized hydraulic system and list down basic components of the same.	**03**
	(b)	Differentiate between open loop and closed loop system with suitable examples.	**04**
	(c)	What is Transfer function? Obtain the transfer function $X_2(s)/F(s)$ of mechanical system shown in Figure 1.	**07**

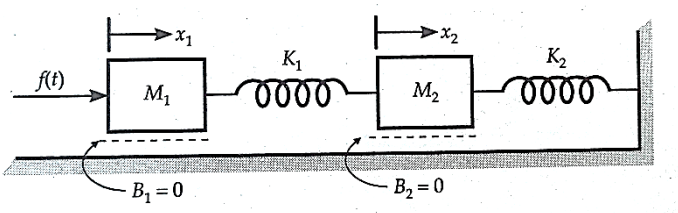

Figure 1

Q.2	**(a)**	What are the benefits of state space representations?	**03**
	(b)	Derive the mathematical model for the thermal system shown in Figure 2 with usual notations.	**04**

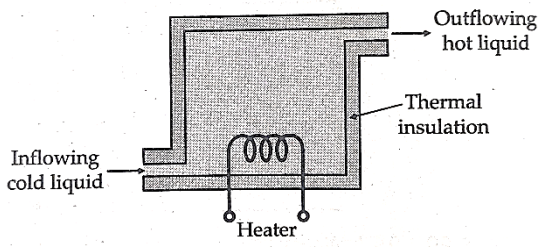

Figure 2

	(c)	Reduce block diagram as shown in Figure 3 and obtain transfer function C/R_2.	**07**

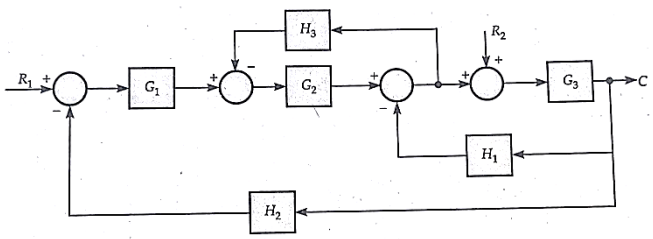

Figure 3

OR

(c) Using Mason Gain formula, derive the transfer functions from signal flow graph shown in Figure 4. **07**

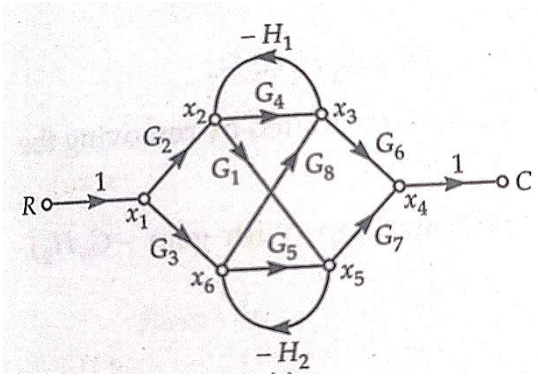

Figure 4

Q.3 **(a)** Discuss the effect of damping ratio on pole positions of 2nd order system. **03**

(b) Determine the range of K for which the following system is stable. **04**

$$2s^3+3s^2+s+K=0$$

(c) The open-loop transfer function of a unity feedback system is $G(s)=\frac{4}{s(s+1)}$. Determine the nature of response of the closed loop system for a unit step input. Also, determine the rise time, peak time, peak overshoot and settling time. **07**

OR

Q.3 **(a)** Discuss the effect of time constant (T) on 1st order step response. **03**

(b) Draw generalized step response of 2nd order underdamped system and define following terms. **04**
1. Delay time, 2. Peak time, 3. Maximum overshoot.

(c) Open loop transfer of a control system is given by, $G(s)H(s)=\frac{K}{s(s+2)(s+4)}$. Draw root locus. **07**

Q.4 **(a)** State the advantages of frequency response analysis. **03**

(b) Explain the effects and limitations of Lag compensation. **04**

(c) Construct the Bode plots for a unit feedback control system, $G(s)=\frac{2000}{s(s+1)(s+100)}$. Also comment on the stability of the system. **07**

OR

Q.4 **(a)** Define following terms: **03**
1. Gain margin, 2. Cutoff rate, 3. Phase margin.

(b) Explain Nyquist stability criterion with suitable example. **04**

(c) A second order system has overshoot of 50% and period of oscillation 0.2 second in step response. Determine resonant peak, resonant frequency and bandwidth. **07**

Q.5 **(a)** Draw symbol of following pneumatic components: **03**
1. 3/2 DCV, 2. FRL unit, 3. Air compressor.

(b) Differentiate between hydraulic and pneumatic systems. **04**

(c) With neat sketch explain the working of Hydraulic PI controller and derive the transfer function. **07**

OR

Q.5 **(a)** List down different sources of hydraulic power and briefly explain any one with neat sketch. **03**

(b) Derive the state model for the RLC circuit shown in Figure 5. Select i_L and v_c as state variables. **04**

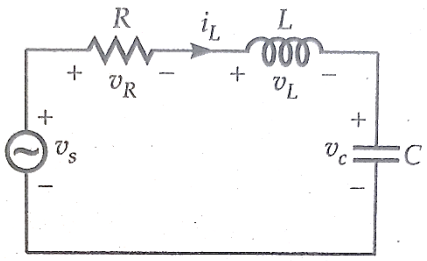

Figure 5

(c) With the help of neat sketch explain a pneumatic flapper amplifier and determine its transfer function. **07**

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