Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3151908 Date:22/01/2021

Subject Name:Control Engineering

Time:10:30 AM TO 12:30 PM Total Marks: 56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define following related to control systems: (i) Transfer Function, (ii) Poles & (iii) Zeros	**03**
	(b)	Explain various rules of block-diagram reduction with neat sketches.	**04**
	(c)	Discuss Force-Current analogy with suitable example.	**07**
Q.2	**(a)**	Explain the linearization of non-linear systems with a suitable sketch.	**03**
	(b)	Define controlled variables and manipulated variables with suitable example.	**04**
	(c)	Differentiate between open loop and closed loop control systems with suitable examples.	**07**
Q.3	**(a)**	Define Rise time, Peak time and Settling time for unit step response of second order systems.	**03**
	(b)	Discuss briefly about standard input test signals for time domain systems with neat sketches.	**04**
	(c)	A unity feedback control system has its open-loop transfer function given by $G(s) = \frac{4s+1}{4s^2}$ Determine and expression for the time response when the system is subjected to Unit step input.	**07**
Q.4	**(a)**	Define following related to state-space analysis of a control system: (i) State, (ii) State variables, (iii) State space	**03**
	(b)	Determine stability of a close-loop system using Routh-Hurwitz criterion whose characteristics equation is $s^3 + 4.5s^2 + 3.5s + 15 = 0$	**04**
	(c)	Obtain unit step response of first order system and discuss steady state error for the same.	**07**
Q.5	**(a)**	Write any three salient features of Root Locus plot.	**03**
	(b)	Explain the concepts of Observability and Controllability.	**04**
	(c)	Explain the procedure of drawing Bode plot and determination of gain margin, phase margin and stability with a suitable example.	**07**
Q.6	**(a)**	Write steady state error coefficients for type ‘0’system with Unit step, Unit ramp and Unit parabolic inputs.	**03**
	(b)	Briefly discuss about the relative stability from Nyqist plot.	**04**
	(c)	Explain experimental determination of close loop transfer function with suitable example.	**07**
Q.7	**(a)**	Explain tuning of a PID controller in brief.	**03**

	(b)	Explain hydraulic proportional plus derivative controller with neat sketches.	**04**
	(c)	Explain working of hydraulic PID controller with neat sketches and write transfer function for the same with usual notations.	**07**
Q.8	**(a)**	Explain briefly various elements of pneumatic circuit.	**03**
	(b)	Compare hydraulic and electrical control systems.	**04**
	(c)	Sketch a schematic diagram of pneumatic nozzle-flapper amplifier system and explain its working. Sketch and explain characteristic curve relating nozzle back pressure and nozzle flapper distance for the same.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2021

Subject Code:3151908 Date:15/12/2021

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)**	Discuss about the requirements of good control system.	**03**
	(b)	Explain Hydraulic PID controller with neat sketch.	**04**
	(c)	Obtain the transfer function for hydraulic system with proportional plus Integral plus derivative control action.	**07**
Q.2	**(a)**	State the advantages of state-space representation over conventional control system analysis method.	**03**
	(b)	What does a block diagram represent? List its salient characteristics.	**04**
	(c)	What is Modern control theory? Compare Modern control theory with conventional control theory.	**07**
		OR	
	(c)	Draw a neat sketch of generalized hydraulic control system. Explain the elements of hydraulic control system in brief.	**07**
Q.3	**(a)**	For an RLC circuit, Derive the state model	**03**
	(b)	Explain about the transient and steady state response of the system. Also list out the standard test signals and explain any one of them.	**04**
	(c)	Derive unit-step response for first-order control system. Discuss salient features of the response curve and error curve with a neat sketch.	**07**
		OR	
Q.3	**(a)**	What is meant by Step input, Impulse input and Ramp input?	**03**
	(b)	Draw generalized unit step response for 2^{nd} order system and define following: Rise time, Delay time, Settling time.	**04**
	(c)	Derive transfer function of room heating system with usual notations.	**07**
Q.4	**(a)**	Define the following terms: (1) Resonant peak (2) Gain Margin	**03**
	(b)	Describe with neat sketch of a pneumatic proportional controller.	**04**

	(c)	Briefly discuss performance specifications of frequency response analysis for linear controls systems.	**07**

OR

Q.4	**(a)**	What is Transfer function? Write down Advantages and disadvantages of Transfer function.	**03**
	(b)	Discuss the effect of time constant on first order system response for unit step input.	**04**
	(c)	Explain pneumatic proportional plus integral control action and obtain its transfer function.	**07**
Q.5	**(a)**	List out the basic elements of a Pneumatic system.	**03**
	(b)	Discuss about gain margin and phase margin for frequency response of control system.	**04**
	(c)	Derive unit impulse response for a generalized second order system for underdamped, critically damped and overdamped cases with usual notations. Also derive the relation of maximum overshoot (for underdamped case).	**07**

OR

Q.5	**(a)**	Write the comparison between a Pneumatic system and Hydraulic system.	**03**
	(b)	Discuss the effect of damping on the position of closed loop poles of the 2^{nd} order system with diagram.	**04**
	(c)	Discuss stepwise procedure of plotting the root-locus for a given open-loop transfer function	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2021

Subject Code:3151908 Date:07/09/2021

Subject Name:Control Engineering

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)**	Define transfer function. List important characteristics of transfer function.	**03**
	(b)	Explain closed loop control system by giving any two examples.	**04**
	(c)	Find out transfer function of given block diagram as in fig.1 using block diagram reduction technique.	**07**
Q.2	**(a)**	Explain standard test signals used in control engineering	**03**
	(b)	Derive unit step response of first order system with usual notations.	**04**
	(c)	Find out transfer function $I_2(s) / V(s)$ for given network as shown in fig.2	**07**
		OR	
	(c)	Explain Force-Voltage and Force-Current analogy.	**07**
Q.3	**(a)**	What is a signal flow graph? State properties of signal flow graph.	**03**
	(b)	Compare block diagram representation versus Signal flow graph representation.	**04**
	(c)	Find out transfer function of given signal flow graph using mason's gain formula as shown in fig.3.	**07**
		OR	
Q.3	**(a)**	List its salient characteristics of Block Diagram. Explain the following: Summing point, takeoff point.	**03**
	(b)	What are poles, zeros & order of transfer function?	**04**
	(c)	Find out transfer function of given signal flow graph using mason's gain formula as shown in fig.4.	**07**
Q.4	**(a)**	Explain the method of finding angle of departure from the complex pole in root locus method.	**03**
	(b)	What's frequency response analysis? List out advantages of it.	**04**
	(c)	A feedback control system has an open loop transfer function $G(s) = \frac{K}{s(s+3)(s^2+2s+2)}$, Draw the root locus as K varies from 0 to ∞.	**07**
		OR	
Q.4	**(a)**	Enlist limitations of Routh's stability criterion.	**03**
	(b)	Explain in brief the following frequency response specifications: 1) Resonant peak 2) Resonant frequency 3) Bandwidth.	**04**
	(c)	Define root locus for a given transfer function $G(s) = \frac{K}{s(s+1)(s+4)}$ find the value of gain K at S= 1±j	**07**
Q.5	**(a)**	What do you mean by Controllers? List the basic types of control action.	**03**

(b) With the help of necessary diagram, explain Pneumatic nozzle flapper amplifier. **04**

(c) Explain pneumatic proportional plus integral control action and obtain its transfer function. **07**

OR

Q.5 **(a)** Explain basic hydraulic system component and draw any circuit showing at least six components **03**

(b) Write the comparison between a Pneumatic system and Hydraulic system. **04**

(c) Obtain the transfer function for hydraulic system with proportional plus integral derivative control action. **07**

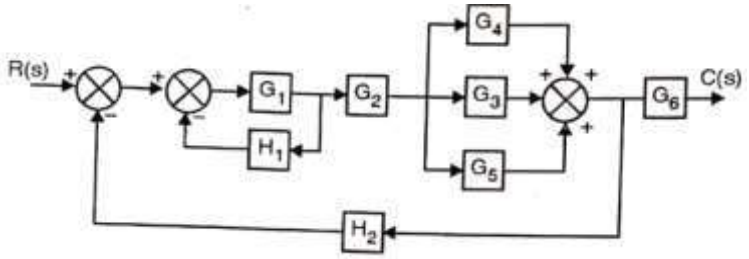

Fig.1

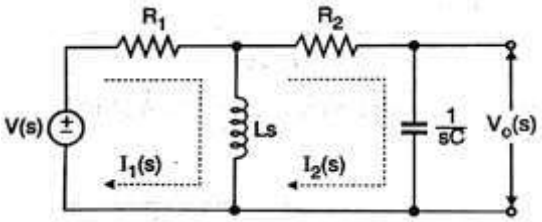

Fig.2

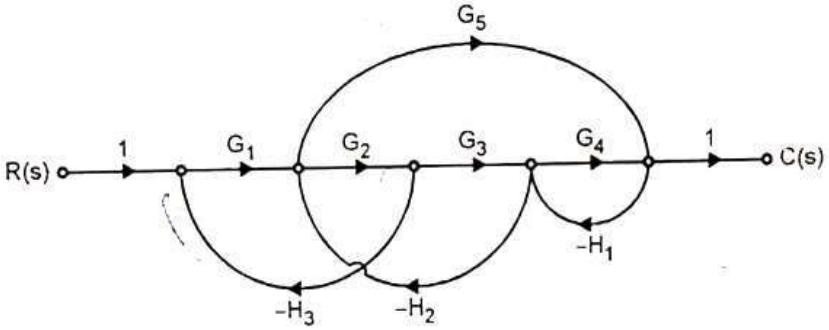

Fig.3

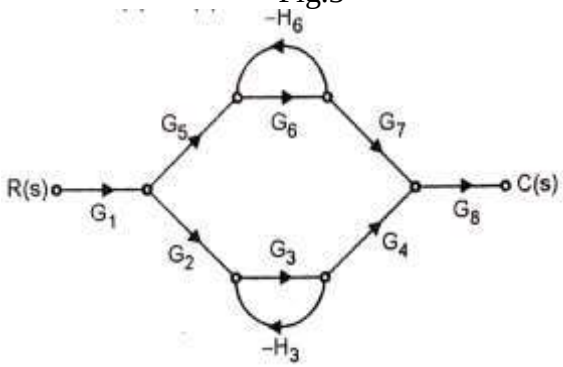

Fig.4

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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**

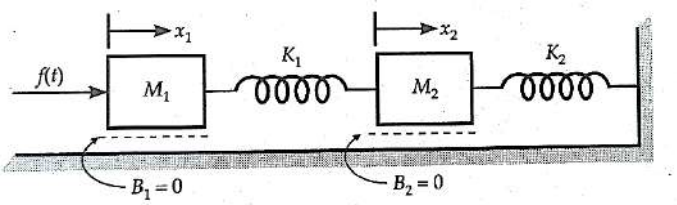

Figure 1

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**

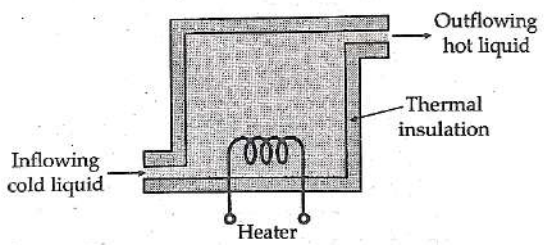

Figure 2

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

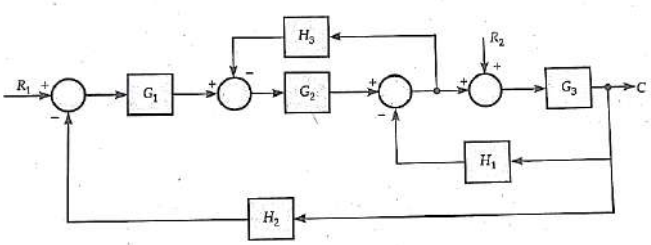

Figure 3

OR

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

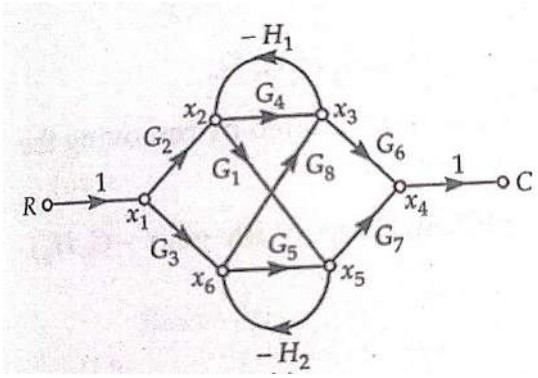

Figure 4

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**

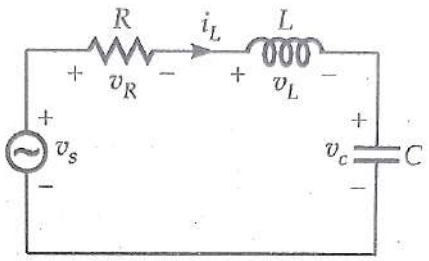

Figure 5

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

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