

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 Nyquist 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

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|------------|-----|--|-----------|
| | (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 |

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:	03
	(1) Resonant peak (2) Gain Margin	
	(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 2nd order system with diagram. **04**

- (c) Discuss stepwise procedure of plotting the root-locus for a given open-loop transfer function **07**

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 $S = 1 \pm j$	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**

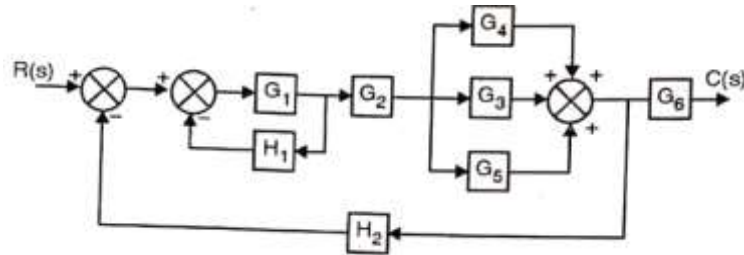


Fig.1

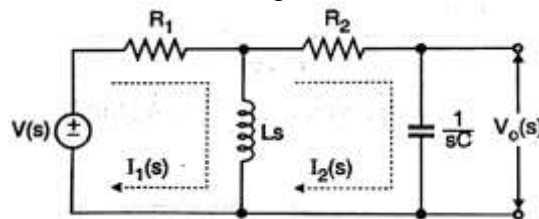


Fig.2

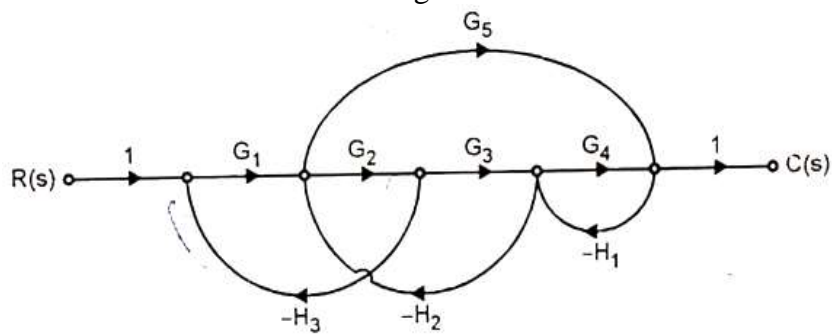


Fig.3

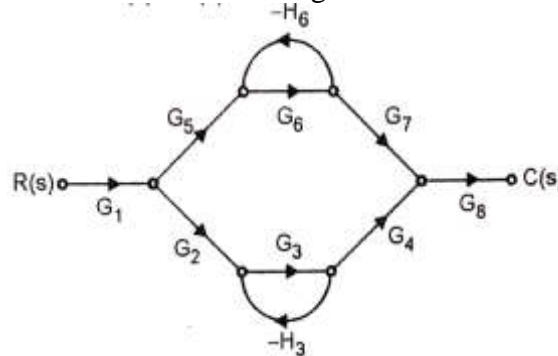


Fig.4

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 |

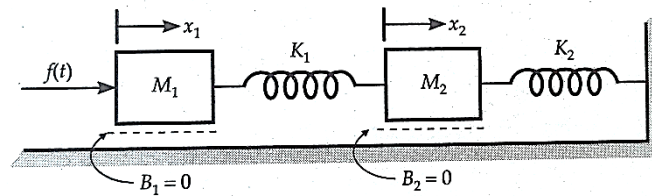


Figure 1

- 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 |

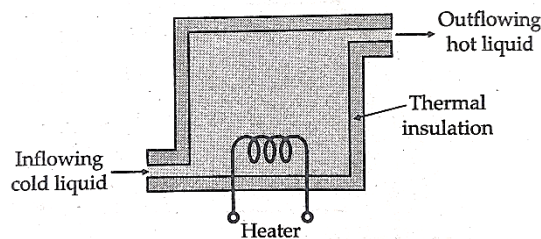


Figure 2

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

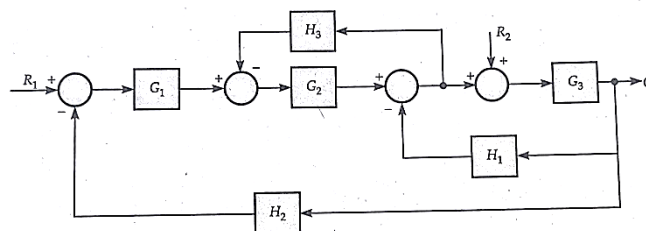


Figure 3

OR

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

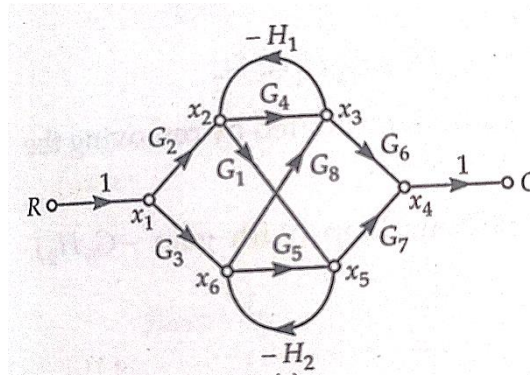


Figure 4

- 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, 07

$$G(s)H(s) = \frac{K}{s(s+2)(s+4)}$$
. Draw root locus.
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, 07

$$G(s) = \frac{2000}{s(s+1)(s+100)}$$
. Also comment on the stability of the system.

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**

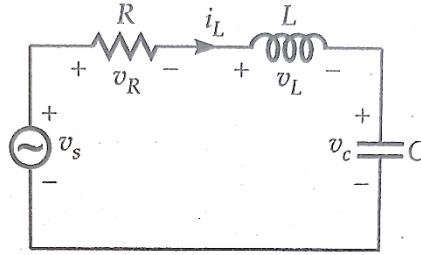


Figure 5

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