Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

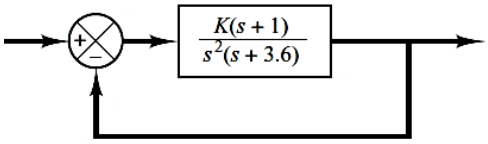
Subject Code:3151908 Date:05-12-2023

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 and state its properties for closed loop system.	**03**
	(b)	Compare Open loop and closed loop control systems.	**04**
	(c)	Using block diagram reduction technique, obtain the overall transfer function of the system whose block diagram is as given in Fig. - 1	**07**
Q.2	**(a)**	Define: State, state vector and State space.	**03**
	(b)	Enlist the type of controllers. Explain Two position On-off controller with neat sketch.	**04**
	(c)	Obtain Transfer function and state space model for the electrical system shown in Fig. 2.	**07**
		OR	
	(c)	Use Mason's Gain formula, Obtain the transfer function of the control system shown in Fig. 3	**07**
Q.3	**(a)**	Define the terms: 1. Peak time 2. Maximum overshoot 3. Rise time 4. Settling time	**03**
	(b)	Find the range of K for stability using Routh's stability criteria for the unity feedback system whose open loop transfer function is given by $$G(s) = \frac{K}{s(s+1)(s+2)}$$	**04**
	(c)	Determine the values of K and k of the closed-loop system shown in Fig. 4 so that the maximum overshoot in unit-step response is 25% and the peak time is 2 sec. Assume J=1 kg-m^2.	**07**
		OR	
Q.3	**(a)**	Determine: i) Poles ii) Zeros iii) Characteristic equation For the control system represented by following equation. $$T(S) = \frac{K(S+5)}{S(S+1)(S-2)(S^2+7S+12)}$$	**03**
	(b)	Explain the terms:(1) steady state error (2) Time constant	**04**
	(c)	Sketch the root loci for the system shown below: 	**07**
Q.4	**(a)**	List out the advantages of frequency response analysis	**03**
	(b)	Explain Nyquist stability criterion for frequency response unity feedback systems with suitable example.	**04**

	(c)	Explain Phase margin and Gain margin related to frequency response.	**07**

OR

Q.4	**(a)**	What is lag and lead compensation for frequency response analysis?	**03**
	(b)	What is Bode plots. State its advantages.	**04**
	(c)	Write a short note on Relative stability for frequency response method with neat sketches for various stabilities.	**07**
Q.5	**(a)**	Write a short note on pneumatic actuating valve.	**03**
	(b)	Explain the working principle of nozzle-flapper with neat line sketch.	**04**
	(c)	Compare the features, merits and demerits of pneumatic system and hydraulic system in detail.	**07**

OR

Q.5	**(a)**	Explain the importance of FRL unit of the pneumatic system.	**03**
	(b)	Draw a generalized hydraulic control system and state function of each component.	**04**
	(c)	Write a note on working of Hydraulic Proportional plus integral (PI) controller with neat sketch and obtain the transfer function of the same.	**07**

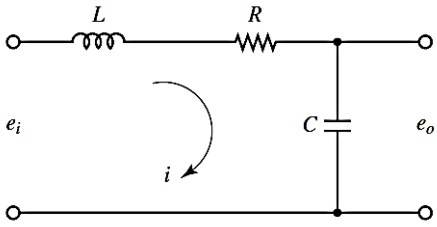


Fig. 2 Mathematical modelling (Q.2(C))

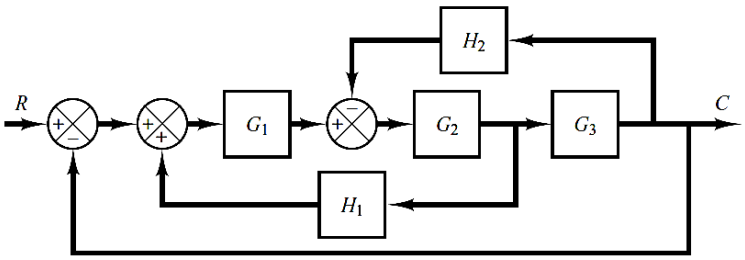


Fig. 1 Block diagram reduction (Q.1(C))

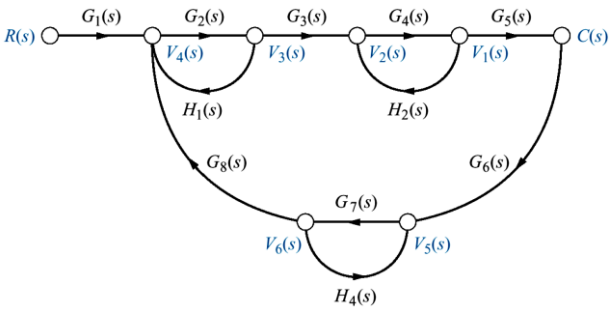


Fig. 3 Signal flow graph – OR (Q. 2(c))

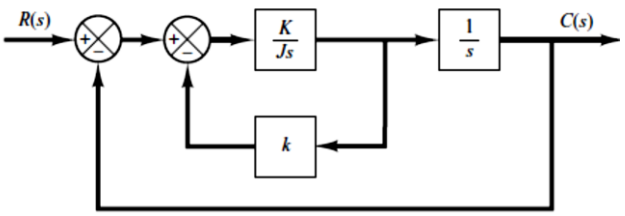


Fig. 4 Feedback control system, (Q. 3(c))

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