Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2151908 **Date: 19/06/2019**

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.**

			MARKS
Q.1	**(a)**	What are the limitations of Open-loop system over Closed-loop systems? List the advantages of Closed-loop system.	**03**
	(b)	State, giving reasons, whether the following are open loop or closed loop control systems. (1) Automatic Washing machine (2) Walking on the road (3) The traffic control system used in road crossings in typical Indian cities (4) Maintenance of normal body temperature of a human being.	**04**
	(c)	Define Transfer function. Obtain the transfer function of mechanical network shown in Figure **I**.	**07**

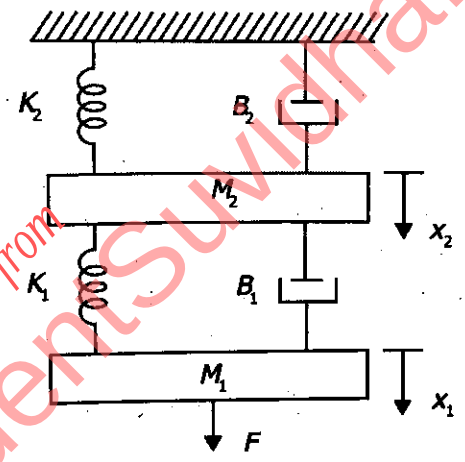


Fig **I**

Q.2	**(a)**	What is a signal flow graph? State properties of signal flow graph.	**03**
	(b)	From a given signal flow graph Figure II using Mason's gain formula deduce overall transmittance.	**04**

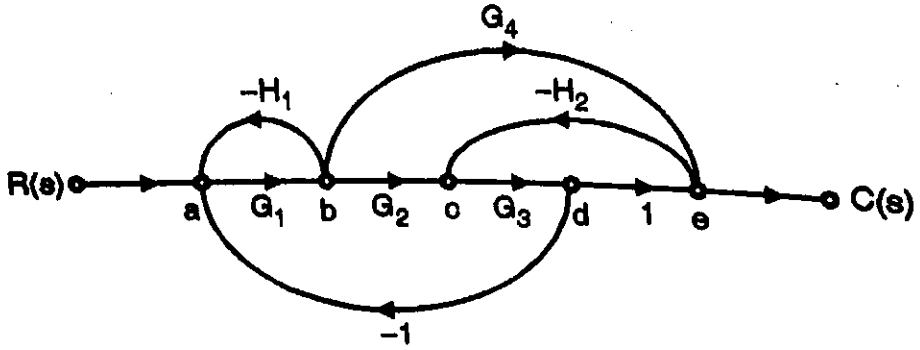
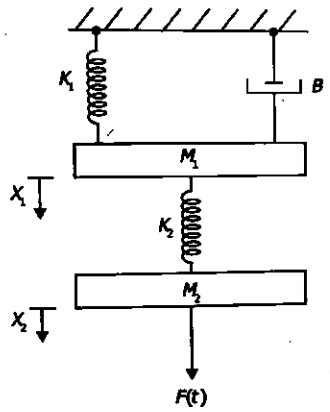
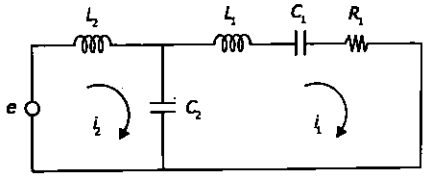


Fig. **II**

(c) Show that the circuit of Fig. **(b)** is the analogous electrical network for the system shown in Fig **(a)** using force- voltage analogy. Take damper as B_1 in Fig (a) **07**



(a)



(b)

OR

(c) Obtain the transfer function of the mechanical system shown in Fig III and draw its analogous circuit. Also derive its transfer function. **07**

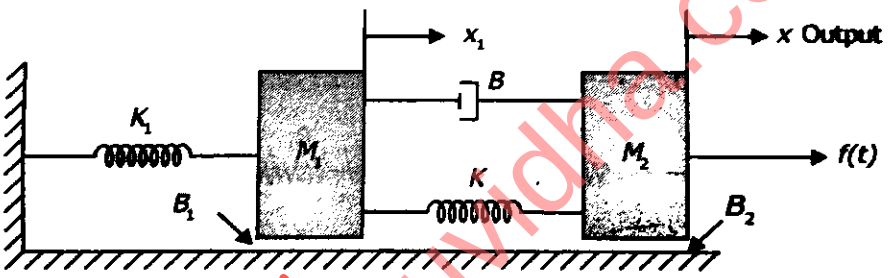


Fig. **III**

Q.3 (a) Write differences between Hydraulic and Pneumatic control systems. **03**

(b) What do you mean by a block diagram? What is meant by summing point and takeoff point? State the advantages of block diagram representation. **04**

(c) Reduce the block diagram as shown in Fig. IV and obtain overall transfer function. **07**

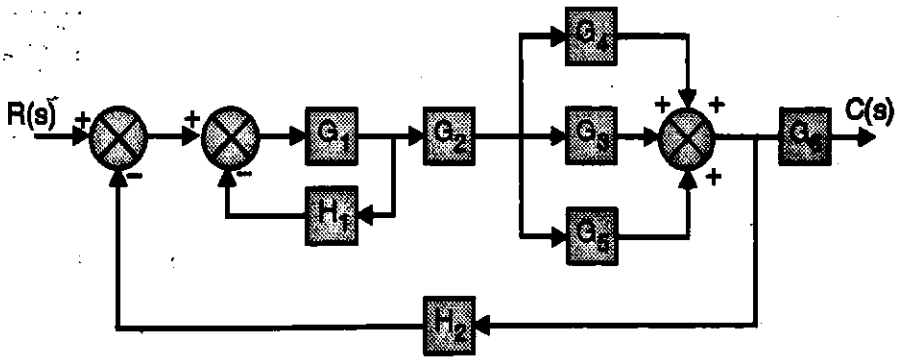


Fig. **IV**

OR

Q.3 **(a)** Explain in brief Routh's stability criterion. **03**

(b) Find the range of values of k for which system, represented by the following expression is stable. **04**

$$S^3 + 30\,S^2 + 600\,s + 600\,k = 0$$

(c) Define the term 'Root locus'. **07**

A Feedback control system has open-loop transfer function

$$G(s)H(s) = \frac{K\,(s+30)}{(s+1)(s+10)(s+20)}$$

Draw the root locus as K varies from **0** to ∞.

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

(b) Explain in brief the following frequency response specifications: **04**

1) Resonant peak 2) Resonant frequency 3) Bandwidth.

(c) A unity feedback control system has **07**

$$G(s) = \frac{r}{s(s+r)}$$

(1) Determine value of 'r 'so that maximum overshoot is 40 %

(2) For this value of r, determine resonant peak value and resonant frequency.

OR

Q.4 **(a)** Discuss various types input test signals used for time response analysis of a control system. **03**

(b) Derive unit step response of first order system with usual notations. **04**

(c) The open-loop transfer function of a unity feedback system is , **07**

$$G(s) = \frac{4}{s(s+1)}$$

Determine the nature of the closed-loop system for a unit-step input. Also, determine the rise time, peak time, peak overshoot and settling time.

Q.5 **(a)** Explain in brief Pneumatic PI controller. **03**

(b) Obtain state model for the following transfer function. **04**

$$\frac{C(s)}{R(s)} = \frac{(s+2)}{(s+1)(s+3)}$$

(c) Explain in brief Hydraulic PID controller with a neat diagram. **07**

OR

Q.5 **(a)** What do you mean by Controllers? List the basic types of control action. **03**

(b) Explain generalized hydraulic control system with a neat sketch. **04**

(c) Write short note on : **07**

(1) Nozzle-Flapper amplifier

(2) Compare Modern control theory with conventional control theory

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