Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2018

Subject Code:2151908 **Date:09/05/2018**

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)**	Define transfer function. List important characteristics of transfer function.	**03**
	(b)	What is a time varying system? Give suitable examples. How is it different from the time invariant system?	**04**
	(c)	Obtain the transfer function Y(s)/U(s) of the system shown in figure 1. The displacement input is u(t).	**07**
Q.2	**(a)**	Find transfer function equation for simple mass-spring-dashpot system with usual notation.	**03**
	(b)	Tabulate the various analogous elements in mechanical and electrical systems.	**04**
	(c)	Derive expressions of rise time and peak time for a second order under damped system excited by a unit step input.	**07**
		OR	
	(c)	Define following terms in context with the transient response specifications of second order system using neat sketch: Delay time, Rise time, Peak time, Maximum overshoot, settling time.	**07**
Q.3	**(a)**	What does a block diagram represent? Explain it in detail.	**03**
	(b)	List its salient characteristics of Block Diagram. Explain the following: Summing point, takeoff point.	**04**
	(c)	Reduce block diagram as shown in figure 2 by using block diagram reduction rules and obtain overall transfer function.	**07**
		OR	
Q.3	**(a)**	What is signal flow graph? Can the gain formula be applied between any two nodes of a SFG?	**03**
	(b)	Compare block diagram representation versus Signal flow graph representation.	**04**
	(c)	For the signal flow graph of a multiple loop system shown in figure 3, determine C(s)/R(s) using Mason's gain formula.	**07**
Q.4	**(a)**	Enlist limitations of Routh's stability criterion.	**03**
	(b)	Using R-H criterion determine the stability of the system whose characteristic equation is given by : $s^5 + 1.5s^4 + 2s^3 + 4s^2 + 5s + 10 = 0$	**04**
	(c)	Draw root locus diagram for the system with transfer function,	**07**

G(s). H(s) = $\frac{k}{s(s+3)(s+6)}$. Obtain value of k when ζ =0.6 from root locus. Determine the value of k for stability and critical damping.

OR

Q.4 **(a)** State 'Angle condition' and 'Magnitude condition' of root locus method. **03**

(b) Determine the stability of the system represented by the characteristic equation by means of the R-H Criterion. Also find root lying in right half of s-plane. **04**

$s^6 + 3s^5 + 5s^4 + 9s^3 + 8s^2 + 6s + 4 = 0$

(c) The open loop transfer function of unity feedback control system is given by : **07**

G(s). H(s) = $\frac{k}{(s+1)(s+10)(s+30)}$. Draw the root locus. Determine the value of k for which the system becomes critically damped and also the value of k for which the system become unstable.

Q.5 **(a)** Compare hydraulic control system with pneumatic control system in detail. **03**

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

(c) Draw the schematic diagram of Hydraulic PID controller. Explain its working and derive its transfer function. **07**

OR

Q.5 **(a)** State the advantages of state-space representation over conventional control system analysis method. **03**

(b) Explain the following terms: (i) State (ii) State variables (iii) State-space (iv) state transition matrix **04**

(c) Draw the schematic diagram of Pneumatic PI controller. Explain its working and derive its transfer function. **07**

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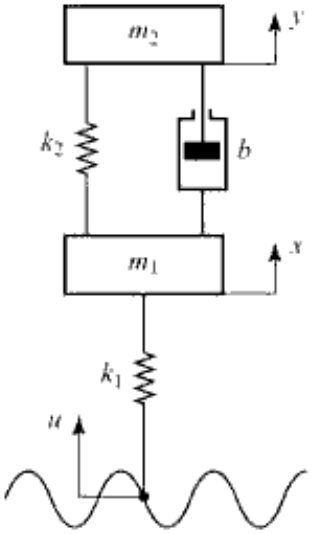

Figure.1

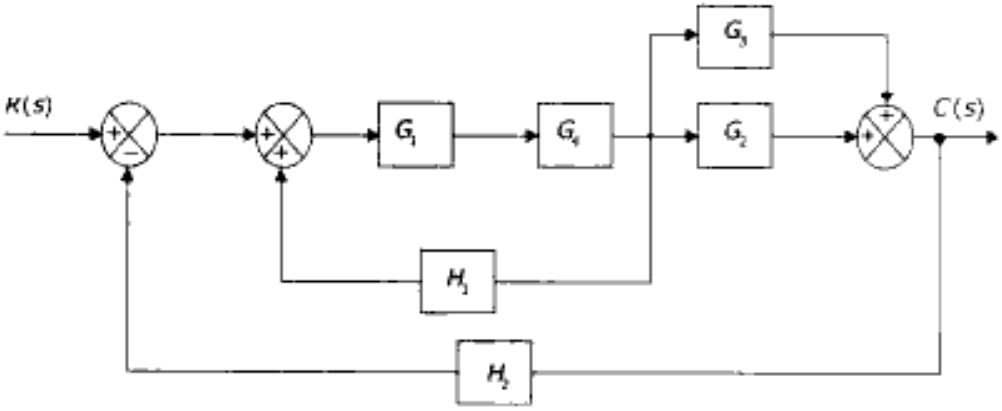

Figure. 2

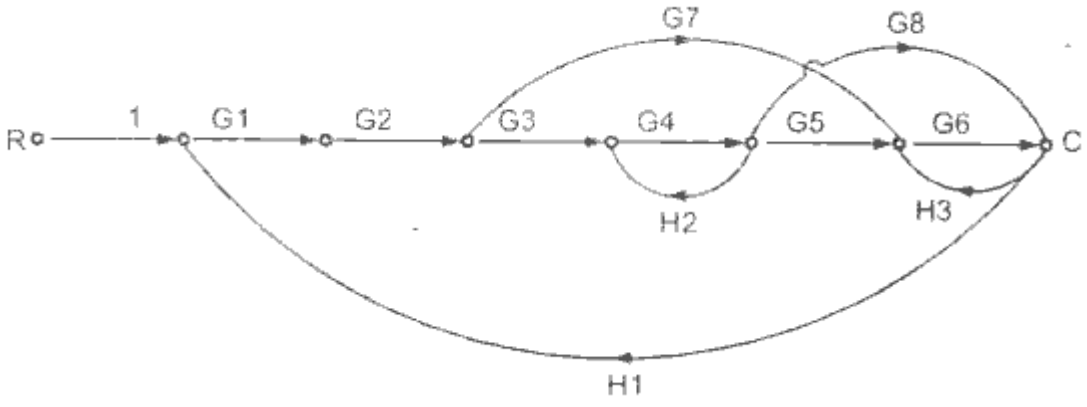

Figure.3