Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2141708 Date:30/05/2016

Subject Name:Control System

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.**

			MARKS
Q.1		**Short Questions**	**14**
	1	Define transfer function.	
	2	Difference between linear and non-linear systems.	
	3	In F-I analogy, the resistance and inductor analogous to _____and _____, respectively.	
	4	In F-V analogy, the viscous friction and spring constant analogous to _____and _____, respectively.	
	5	Define lump parameter systems with example.	
	6	Laplace transform of impulse input is ____.	
	7	Laplace transform of sin(ωt) is _____.	
	8	Inverse Laplace transform of 5/(s+2) is _____.	
	9	For the second order system with unity feedback has open-loop transfer function G(s)=16/[s(s+4)]. Find damping ratio and natural frequency of closed-loop system.	
	10	For the undamped (marginal stable) system, the value of damping ratio is	
	11	For the step input to type-1 system, the steady state error is _____.	
	12	Define root locus.	
	13	What is the input to the system to obtained the frequency response is obtained for the considering which input applied to the system.	
	14	Comment on the roots of polynomial $s^3-s^2+s+3=0$ using RH Criterion.	
Q.2	**(a)**	Obtain second order step response for the under damped case.	**03**
	(b)	Explain Force-voltage analogy.	**04**
	(c)	Find the transfer function X2(s)/F(s) of given mechanical system in Fig.1.	**07**

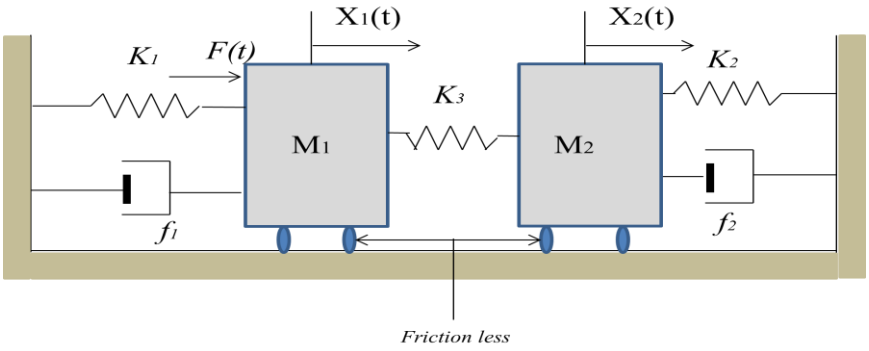

Fig.1 Mechanical system for Q.2.(c)

OR

	(c)	Using a block diagram reduction technique find the closed-loop transfer function of Fig. 2.	**07**

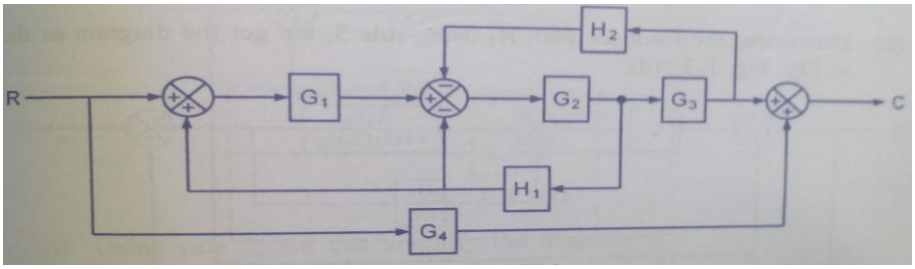

Fig.2 Block diagram of Q.2(c) OR

Q.3 **(a)** Obtain analogous electrical network of the given mechanical system in Fig. 3 based on force-current analogy. **03**

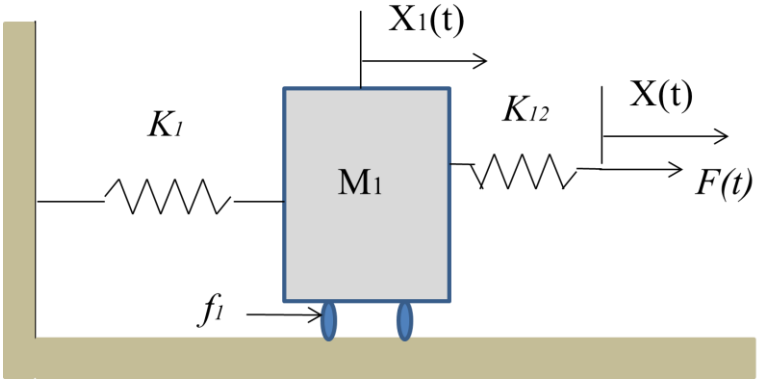

Fig. 3 Mechanical system for Q.3(a)

(b) Obtain the transfer function from the signal flow graph shown in Fig. 4 using the Mason's gain formula. **04**

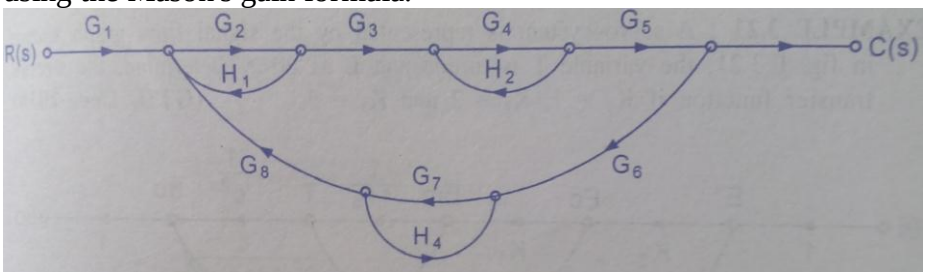

Fig. 4. Signal flow graph for Q.3(b)

(c) List out and define the specifications of second order time response system. Derive equation for the peak overshoot and settling time. **07**

OR

Q.3 **(a)** Using RH criterion finds stability of the characteristic equation given as $s^5+ s^4+ 2s^3+ 2s^2+3s+5=0$. **03**

(b) Explain each term of the Mason's gain formula. **04**

(c) For the unity feedback system having open-loop transfer function G(s)=K/[s(1+Ts)]. Find (i) by what factor K multiply as damping ratio increase from 0.2 to 0.6, (ii) by what factor K multiply as peak over shoot decrease from 80% to 20%. **07**

Q.4 **(a)** Represent transfer function $G(s)=[2s^2+6s+7]/[s^2+4s+3]$ in state variable form. **03**

(b) Write different steps to plot root locus with equations. **04**

(c) For the given open-loop system G(s)=K(s+2)/[s(s+1)]. Plot root locus along with find (i) Valid break away/in points (ii) stability of the system. **07**

OR

Q.4 **(a)** Obtain state space model for the single input and single output system with necessary dimension of matrices. **03**

(b) Define state transition matrix using equation. State its properties. **04**

(c) The open-loop transfer function of the unity feedback system is $G(s)=K/[s(s+4)(s^2+4s+8)]$. Construct root locus of it and find range of K for which system is stable. **07**

Q.5	**(a)**	Define bandwidth, phase margin and gain margin for frequency response.	**03**
	(b)	Draw the polar plot of $G(s)=10/[s(s+2)]$.	**04**
	(c)	Draw the Bode plot for the open-loop transfer function $G(s)=K/[s(s+3)(s+100]$ for the velocity error constant=10. Also find gain cross over frequency, phase cross over frequency, GM and PM.	**07**

OR

Q.5	**(a)**	Explain the Nyquist stability criterion.	**03**
	(b)	Obtain polar plot of $G(s)=1/[s(T_1s+1)(T_2s+1)]$.	**04**
	(c)	For the satellite robot has an open-loop transfer function as $G(s)=40(s+2)/[s(s+0.5)(s^2+8s+9)]$. Draw bode plot for it.	**07**

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