Seat No.: ________ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

Subject Code: 2140307 **Date: 17/12/2019**

Subject Name: Control System and Analysis

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

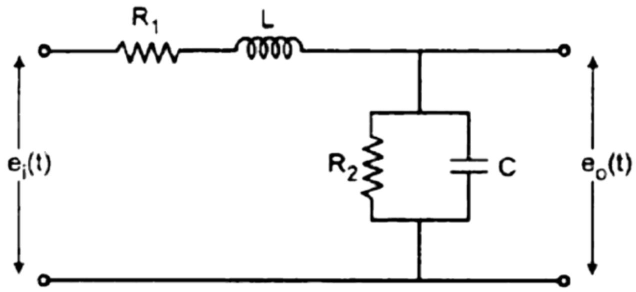
Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

MARKS

Q.1 **(a)** Give difference between close loop & open loop control system with example. **03**

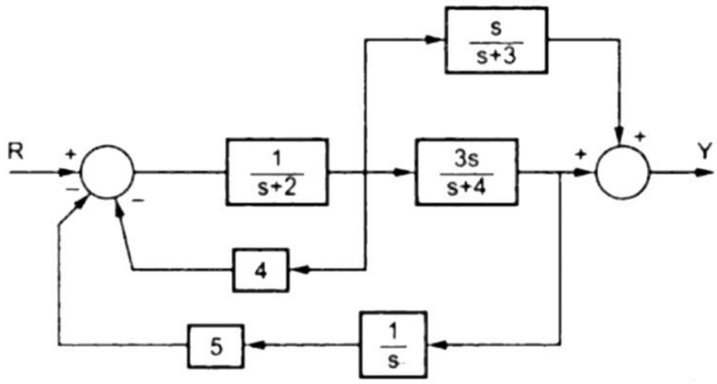
(b) Find the transfer function of below given system. **04**



(c) Obtain the inverse Laplace transform for below given F(s). **07**

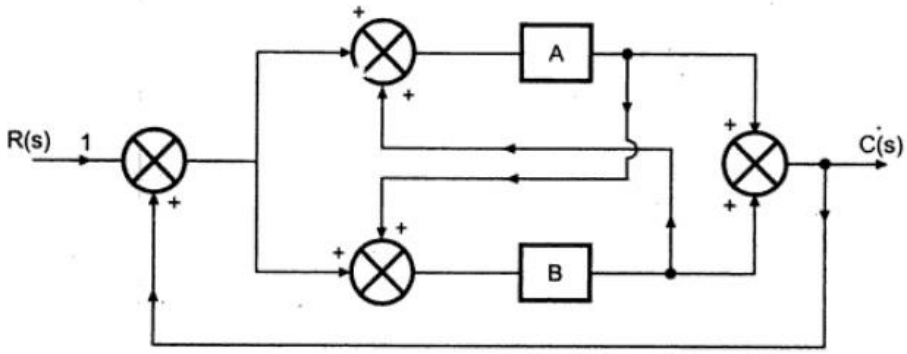
$$F(s) = \frac{(s-2)}{s(s+1)^3}$$

Q.2 **(a)** Calculate the transfer function of below given system using block diagram reduction. **03**



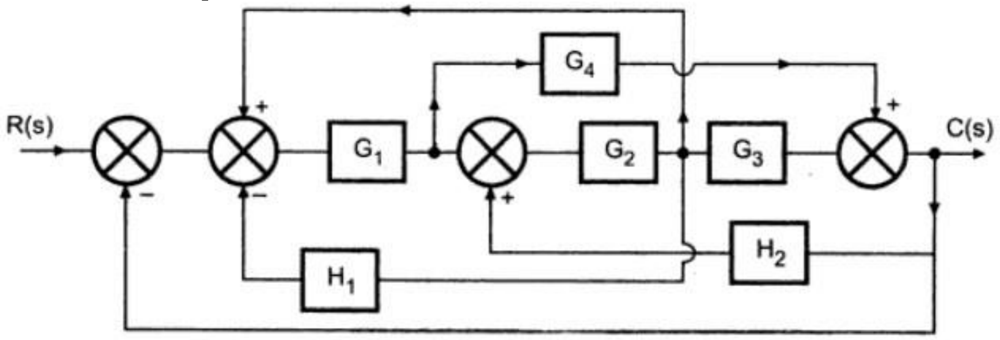
(b) Calculate the roots and draw the pole-zero plot of the system given in Q-2 (a). **04**

(c) Draw the signal flow graph and find the transfer function of below given circuit network using mason's gain formula. **07**



OR

(c) Find the transfer function of below given control system using block diagram reduction technique. **07**



Q.3 **(a)** Define below given terminologies with proper equations. **03**

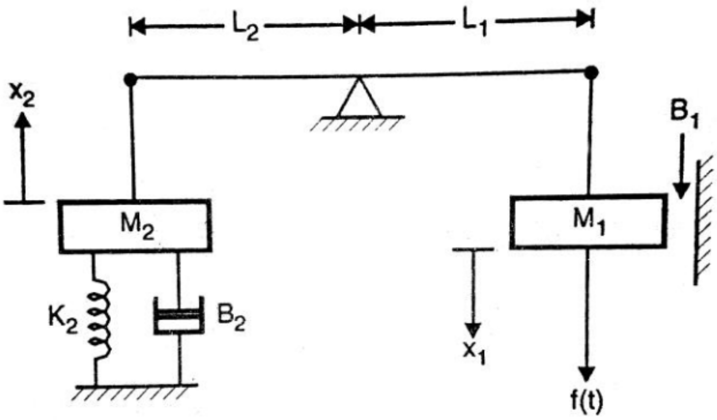
i. Rise Time(t_r)

i. Peak Time(t_p)

i. Peak Overshoot (M_p)

(b) For a unity feedback system $G(s) = \frac{36}{s(s+0.72)}$. Determine the values of natural frequency, damping ratio, peak time, settling time, and peak overshoot for a unit step input. **04**

(c) Draw the equivalent mechanical system & analogous systems based on F-V & F-I methods for below given system. **07**



OR

Q.3 **(a)** Determine the position, velocity & acceleration error constants and steady state error of the system given below. **03**

$$G(s) = \frac{1000}{s(s+10)(s+100)} \quad , H(s) = \frac{20}{s}$$

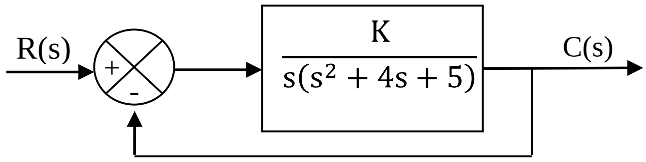
(b) A negative feedback system has a forward path transfer function $G(s) = \frac{K}{s(s+1)}$ and feedback path transfer function $H(s) = (1 + as)$. If this system is to have a peak time of 0.5 sec and a 10% overshoot for a unit step input, determine values of K & a. **04**

(c) Consider the unity feedback control system whose open loop transfer function is $G(s) = \frac{50}{s(1+0.1s)}$. Determine the steady state error and its variation with time when the input is $r(t) = 1 + t + t^2$. **07**

Q.4 **(a)** Comment on the stability of the system represented by below given characteristic equation. **03**

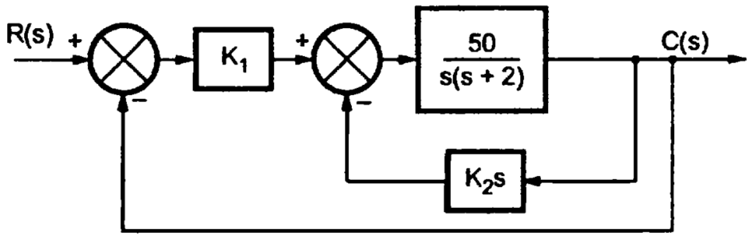
$$s^5 + s^4 + 2s^3 + 2s^2 + 3s + 15 = 0$$

	(b)	Draw the response for Under damped, Critically damped & Over damped systems with necessary equations.	**04**
	(c)	Draw the root locus of the system given below. Find the values of valid break-away-point, interaction with imaginary axis and the range of K for which the system will be stable.	**07**



OR

Q.4	**(a)**	Enlist the demerits of Hurwitz method.	**03**
	(b)	Find the value of K_1 and K_2 so as to obtain peak time = 2 sec, and settling time=5 sec.	**04**



	(c)	Draw the root locus of the system given below. Find the values of valid break-away-point, interaction with imaginary axis and the range of K for which the system will be stable.	**07**

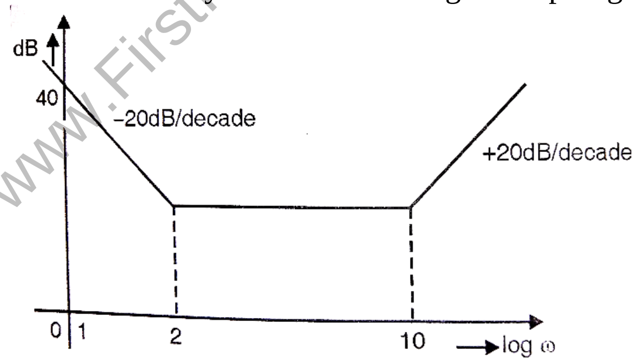
$$G(s)H(s) = \frac{K(s+0.1)}{s(s-0.2)(s^2+s+0.6)}$$

Q.5	**(a)**	Enlist advantages of Nyquist plot.	**03**
	(b)	Find the angle of departure for complex roots of system $G(s)H(s) = \frac{K(s+4)}{s(s^2+2s+2)}$.	**04**
	(c)	To identify system stability conditions using bode plot technique by determine the values of ω_{gc}, ω_{pc}, GM and PM.	**07**

$$G(s)H(s) = \frac{80s^2}{(2s+1)(s+1)(0.2s+1)}$$

OR

Q.5	**(a)**	Find the transfer function of the system from the magnitude plot given below.	**03**



	(b)	Identify whether points s = -1.5 ± j1.8371 are on the root locus of the system	**04**

$$G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+11.25)}$$

	(c)	Draw the Nyquist diagram of below given control system. Find GM and stability from Nyquist plot.	**07**

$$G(s)H(s) = \frac{40}{(s+4)(s^2+2s+2)}$$

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