Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:2150909 **Date:27/11/2018**

Subject Name:Control System 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.**

			MARKS
Q.1	**(a)**	Describe the basic three objectives of any control system.	**03**
	(b)	By applying the final-value theorem, find the final value of f(t) whose Laplace transform is given by $F(s)=\frac{10}{s(s+1)}$. Also verify the result by taking inverse Laplace transform method.	**04**
	(c)	Simplify the block diagram shown in Fig. I using block diagram reduction technique and obtain $\frac{C(s)}{R(s)}$.	**07**

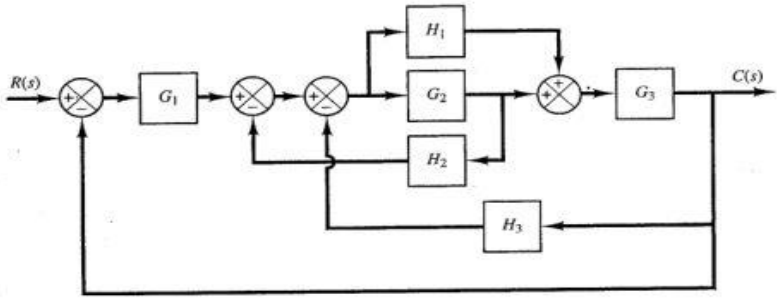

Figure I

Q.2	**(a)**	Draw Signal Flow graph for following set of equations. $x_1 = -x_2 - 3x_3 + 3$ $x_2 = 5x_1 - 2x_2 + x_3$ $x_3 = 4x_1 + x_2 - 5x_3 + 5$	**03**
	(b)	When defining the transfer function, what happens to initial conditions of the system? Give suitable examples.	**04**
	(c)	Find the transfer function C/R shown below for the system using Mason's gain Formula shown in Figure II.	**07**

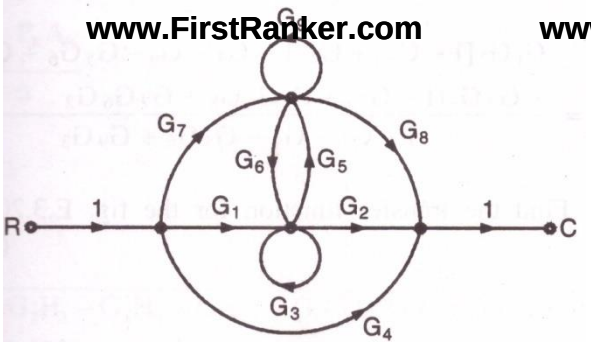

Figure II

OR

(c) Derive the Mason's Gain formula for Signal Flow graph. **07**

Q.3 **(a)** Obtain the unit step response of a unity feedback system whose open loop transfer function is $\frac{2s+1}{s^2}$. **03**

(b) Draw the step response of values of damping ration (i) $\zeta > 1$ (ii) $\zeta=1$ (iii) $\zeta < 1$ (iv) $0<\zeta<1$. **04**

(c) Derive Overall transfer function of Field controlled DC motor. **07**

OR

Q.3 **(a)** Find the steady state error when unit step input is applied to closed loop transfer function $G(s)=\frac{9}{s+10}$. **03**

(b) Define Magnitude and angle criteria for the Root Locus analysis. **04**

(c) For the figure shown in figure. III determine the value of K and k such that the system has a damping ratio ζ of 0.7 and an undamped natural frequency wn of 4 rad/sec. **07**

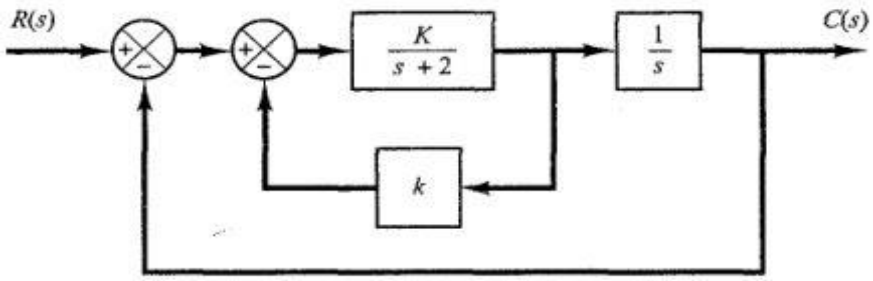

Figure III

Q.4 **(a)** Define Magnitude Plot and Phase plot of bode plot. **03**

(b) Define Gain Margin and Phase margin from Nyquist plot. **04**

(c) Consider the following Characteristic equation **07**

$$s^4 + ks^3 + s^2 + s + 1 = 0$$

Determine the range of K for stability.

OR

Q.4 **(a)** How stability can be ensured from Routh Table? **03**

(b) How stability can be ensured from Open loop poles and closed loop poles? **04**

(c) Draw the Rough sketch of the root Locus for the given transfer function. **07**

$$G(s) = \frac{k(s+2)}{s\text{^}2 + 2s + 3}$$

Q.5 **(a)** Determine the roots s= -1.5, s= -1.8 and s= -4 is a part of root locus or not for the given transfer function using angle criterion. **03**

$$\frac{K(s+2)(s+3)}{s(s+1)}$$

(b) Define the Gain margin and phase Margin when Gain and Phase cross-over frequency is zero and infinity in bode plot. **04**

(c) Draw the Bode plot and find Gain Margin and Phase margin for the given transfer function. **07**

$$G(s) = \frac{k}{s(1+0.1s)(1+0.5s)}$$

OR

Q.5 **(a)** Comment on the stability using Nyquist plot with the encirclement around the point -1+j0. **03**

(b) Explain the significance of proportional control. **04**

(c) Draw a Nyquist plot for the given transfer function **07**

$$G(s) = \frac{k}{s^2(1+sT1)}$$

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