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.

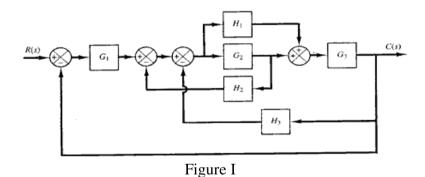
03 04

(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.

(c) Simplify the block diagram shown in Fig. I using block diagram reduction technique and obtain $\frac{C(s)}{R(s)}$.



Q.2 (a) Draw Signal Flow graph for following set of equations.

03

$$x_1 = -x_2 - 3x_3 + 3$$

$$x_2 = 5x_1 - 2x_2 + x_3$$

$$x_3 = 4x_1 + x_2 - 5x_3 + 5$$

- (b) When defining the transfer function, what happens to initial conditions of the system? Give suitable examples.
- (c) Find the transfer function C/R shown below for the system using Mason's gain Formula shown in Figure II.

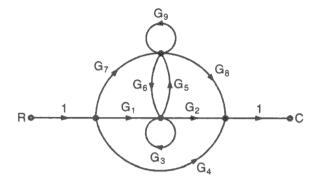


Figure II **OR**

- (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 $\frac{2s+1}{s^2}$.
 - (b) Draw the step response of values of damping ration (i) $\zeta > 1$ (ii) $\zeta=1$ (iii) 04 $\zeta < 1$ (iv) $0 < \zeta < 1$.
 - (c) Derive Overall transfer function of Field controlled DC motor. 07

OF

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

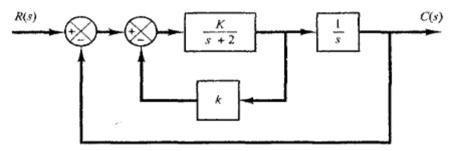


Figure III

- Q.4 (a) Define Magnitude Plot and Phase plot of bode plot.
 - (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?
 - (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

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

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.

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

- (b) Define the Gain margin and phase Margin when Gain and Phase crossover frequency is zero and infinity in bode plot.
- (c) Draw the Bode plot and find Gain Margin and Phase margin for the given transfer function.

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

OR

- Q.5 (a) Comment on the stability using Nyquist plot with the encirclement around the point -1+j0.
 - (b) Explain the significance of proportional control. 04
 - (c) Draw a Nyquist plot for the given transfer function 07

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