Printed Pages: 03 **Sub Code: RIC603**

Paper Id: 131318 **Roll No.** | | | | | | | | | | |

B. TECH.
(SEM VI) THEORY EXAMINATION 2018-19
CONTROL SYSTEM I

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. Write the condition for the system to be controllable.
b. Compare an open loop control system with a close loop control system.
c. What do mean by type and order of the system?
d. State the effect of adding a zero to the forward path transfer function of the system.
e. Differentiate between transient response and steady state response of a system.
f. What will be the steady state error of the type 1 system, when subjected to unit parabolic input?
g. State the relation between unit step and unit ramp signal.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. (i) Establish the correlation between time domain response and frequency domain response of a system (5+2)
(ii) Define the terms: Settling time and Phase Margin

b. Draw the block diagram of a standard second order control system in closed loop form and derive the relation for its time response when subjected to unit step input.

c. (i)Construct state model for the system characterized by the following differential equation: (3+4)

$$\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+6y=4$$

(ii)Check controllability and observability of the following system:

$$A=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -6 & -11 & -6\end{bmatrix} \qquad B=\begin{bmatrix}1\\0\\1\end{bmatrix} \qquad C=[10 \quad 5 \quad 1]$$

d. (i) The open loop transfer function of a control system is given below

$$G(s)H(s)=\frac{2(s^2+3s+20)}{s(s+2)(s^2+4s+10)}$$

Determine static error coefficient and steady state error for the input given as
(1) 5 (2) 4t (3) $4t^2/2$

(ii) Using Routh- Hurwitz criterion, discuss the stability of the following characteristic equation

$$F(s)=s^6+3s^5+6s^4+12s^3+12s^2+12s+8$$ (3+4)

e. The open loop transfer function of a unity feedback system is

$$G(s)=\frac{25}{s(s+5)}$$

Find i) Natural frequency of oscillation ii) Damped frequency of oscillation iii) Damping ratio iv) Maximum over shoot of unit step input.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Using Bode Plot, comment on the stability of the following unity feedback open loop transfer function

$$G(s) = \frac{50}{(s+1)(s+2)}$$

(b) Use Bode Plot to determine the gain K for the open loop transfer function given below so that gain margin is 15 dB

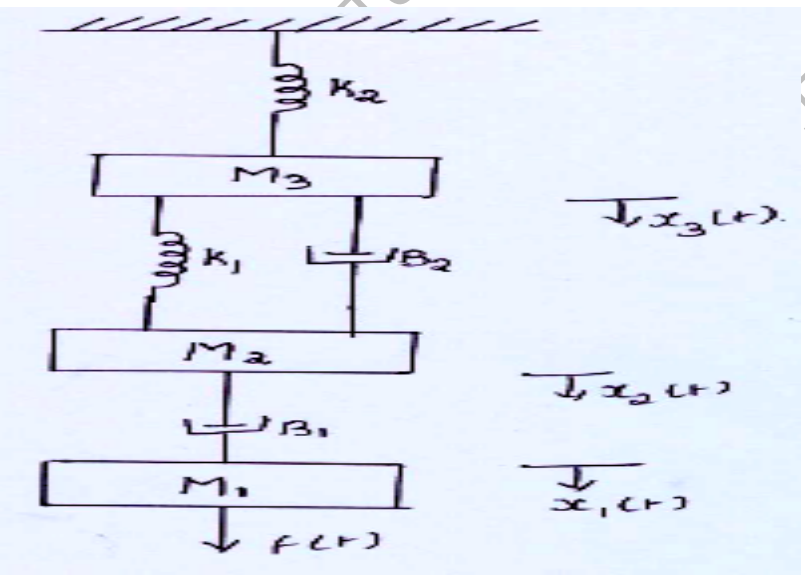
$$G(j\omega)H(j\omega) = \frac{K}{j\omega(0.1\omega+1)(j\omega+2)}$$

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) Using Nyquist plot determine (a) Phase crossover frequency (b) Gain crossover frequency for

$$G(s)H(s) = \frac{2.5K}{s(0.4s+1)(0.2s+1)}$$

(b) Draw the analogous electrical circuit for the system shown below. Use F-V and F-I analogy. All the symbols have usual meaning.



5. Attempt any *one* part of the following: 7 x 1 = 7

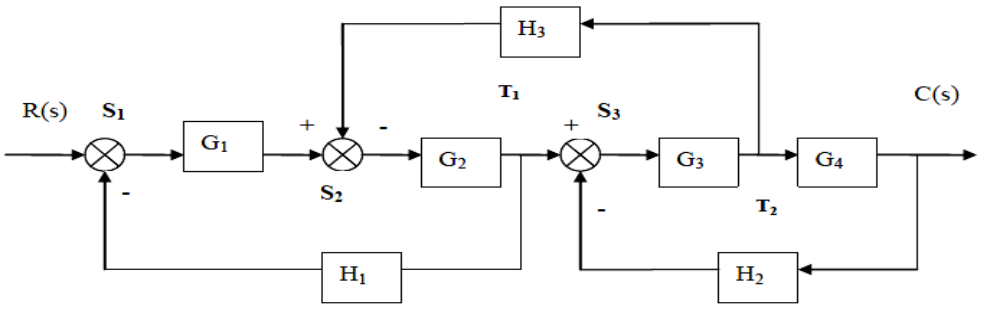
(a) Elaborate the step wise procedure for plotting the root locus of a given open loop transfer function.

(b) Sketch the root locus for the open loop transfer function of a unity feedback control system given below

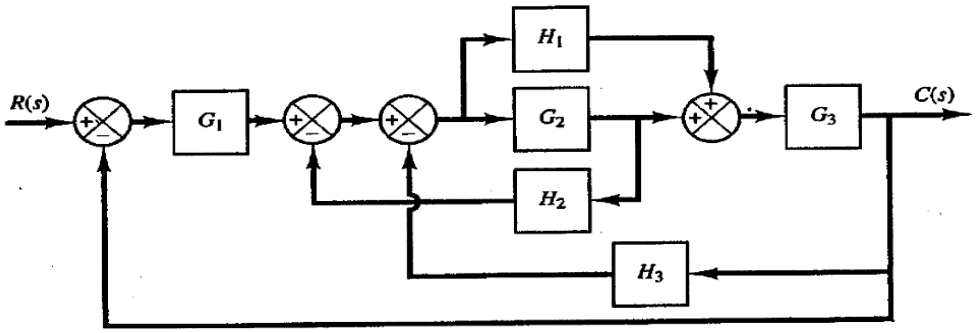
$$G(s) = \frac{K}{s(s+1)(s+3)}$$

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) For the following block diagram, determine over all transfer function using block diagram reduction technique

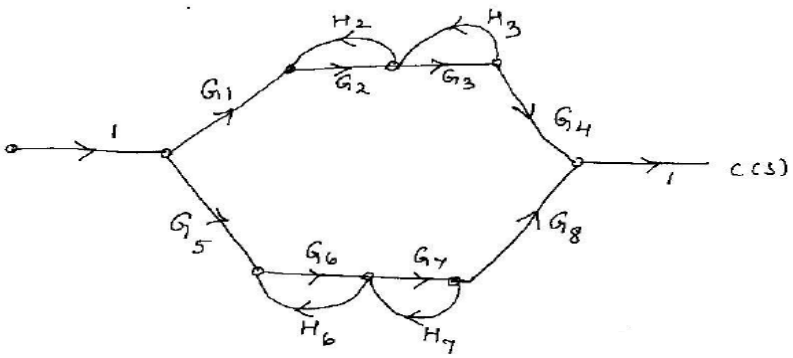


(b) Find overall transfer function using signal flow graph:



7. Attempt any *one* part of the following: 7 x 1 = 7

(a) Using Mason's Gain Formula, find over all transfer function for the following system



(b) Using block diagram reduction technique, find over all transfer function for the following system