Code No: RT31043 **R13** SET - 1

III B. Tech I Semester Regular/Supplementary Examinations, October/November - 2016
CONTROL SYSTEMS
(Comm to ECE and EIE)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Normal and semi & polar graph sheet are the supplied)

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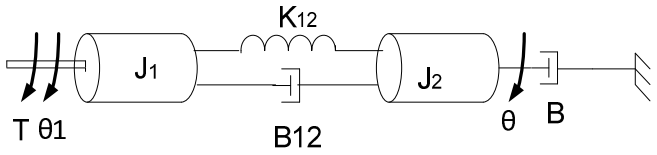
PART –A

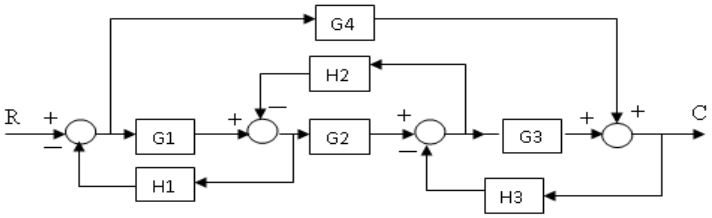
1 a) Define a control system. Explain about open-loop and closed-loop control systems. [3M]
b) Derive the transfer function of Armature controlled DC servo motor. [4M]
c) Define the error constants Kp, Kv and Ka. [4M]
d) Explain about the effects of adding zeroes to G(s)H(s) on the root loci. [3M]
e) Define various Frequency domain specifications [4M]
f) Explain about Lead compensator. [4M]

PART -B

2 a) What are the effects of feedback on Sensitivity and external noise? [8M]
b) Find transfer function θ(s)/T(s). [8M]



3 a) Explain related terms used in Mason's gain formula with examples. [8M]
b) Draw the equivalent signal flow graph and determine $\frac{C(S)}{R(S)}$ using Mason's gain formula. [8M]



4 a) Derive the response of a standard under damped second order system for unit step input. [8M]
b) A unity feed back system has an open-loop transfer function $G(S) = \frac{K}{S(S+10)}$. [8M]
Determine K so that the system will have a damping ratio 0.5. For this value of K, determine peak over shoot and time for peak over shoot for the unit step input.
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5 a) What are rules in construction of root loci ? [6M]

b) For a unity feed back system with open loop transfer function [10M]

$$G(S)H(S) = \frac{K}{S(S+4)(S+6)}$$

Find the range of K for which the system will be stable using RH – Criterion.

6 a) Find the Gain margin and phase margin of the system if the open loop transfer function is : $G(S) = \frac{10}{S(S+1)}$ [8M]

b) Draw the polar plot of $G(S)\,H(S) = \frac{K}{S(S+3)(S+5)}$ and there from determine range of K for stability using Nyquist Criterion. [8M]

7 a) A system is characterized by the following state space equations. [16M]

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \quad t > 0$$

$$y = [1 \quad 0] \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$$

Find the transfer function of the system.
Compute the state transition matrix.
Solve the state equation for the unit step input under zero initial conditions.

Note: SET-1 needs ordinary graph sheets.

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Code No: RT31043 **R13** SET - 2

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Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Normal and semi & polar graph sheet are the supplied)

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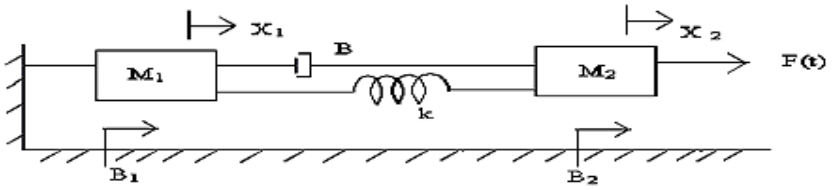
PART –A

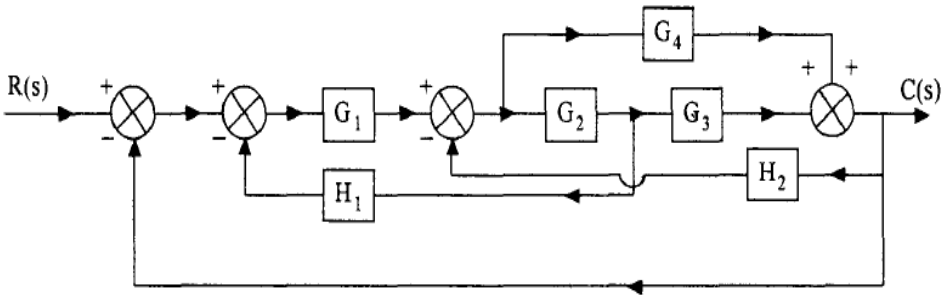
1 a) Write the advantages and disadvantages of open-loop and closed-loop control systems. [3M]
b) Explain about Mason's gain formula. [4M]
c) Write short notes on steady state error. [4M]
d) What are effects of adding poles to G(s)H(s) on the root loci ? [3M]
e) Explain about Phase Margin and Gain Margin. [4M]
f) What are the properties of State Transition Matrix? [4M]

PART -B

2 a) Discuss the effect of feedback on Gain, Stability. [8M]
b) Determine the transfer function $\frac{X_2(S)}{F(S)}$. [8M]



3 a) Explain the construction and operation of AC servomotor . [8M]
b) Obtain the transfer function C(s)/R(s) by using Block diagram algebra. [8M]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4 a) Derive the expressions for peak time and settling time of a standard second order under damped system. [8M]

b) Determine the step, ramp & parabolic error constants for the following system with unity feedback. $G(s) = \frac{K}{s^2(s+1))}$ [8M]

5 a) Find the stability of the system whose characteristic equation is given by [8M]
$P(s) = s^6+2s^5+8s^4+12s^3+20s^2+16s+16.$

b) Sketch the root locus of the system whose open loop transfer function is [8M]
$G(s)H(s)=\frac{k}{s(s+2)(s+4)}$. find the value of k for damping ratio of 0.5

6 a) The open loop transfer function of a unity feedback system is given by [16M]
$\frac{10(s+3)}{s(s+2)(s^2+4s+100)}$ draw the bode plot, find the gain margin and phase margin and comment on stability by bode plot.

7 a) Diogonalize the system matrix, $A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$ [8M]

b) Test the system represented by following equations is state controllable and observable. [8M]

$$[X] = \begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix}[x] + \begin{bmatrix} 3 \\ 1 \end{bmatrix} u \;,\; y = [1 \quad 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Note: SET-2 needs ordinary graph sheets and semi-log graph sheets.

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Code No: RT31043 **R13** SET - 3

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Normal and semi & polar graph sheet are the supplied)

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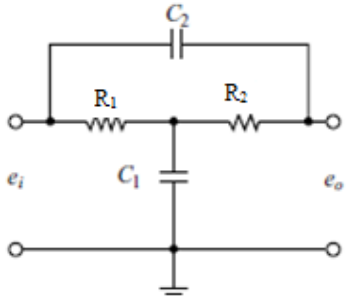
PART –A

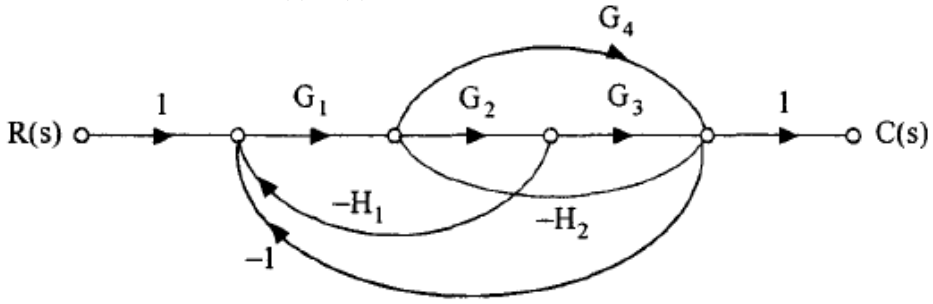
1 a) Compare the open-loop and closed-loop control systems. [3M]
b) Derive the transfer function for AC servomotor. [4M]
c) Derive the response of a standard first order system for unit step input. [4M]
d) What are limitations of Routh's stability criterion? [3M]
e) What is polar plot? Draw the polar plot of G(s)=1/(1+ST) [4M]
f) Explain about Lag compensator. [4M]

PART -B

2 a) Explain about the classification of control systems. [8M]
b) Obtain the transfer functions *E*o(s)/*E*i(s) of the bridged T network [8M]



3 a) Explain the construction and operation of Synchro transmitter and Receiver [8M]
b) Find transfer function C(s)/R(s). [8M]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4 a) Explain about the PID controller. [8M]

b) For a unity feedback system the open loop transfer function is $G(s) = \frac{10(s+2)}{s^2(s+1)}$. [8M]

Find the positional , velocity and acceleration error constants .

Find also steady state error when the input is $R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{s^3}$.

5 a) A unity feed back system with forward path transfer function [8M]

$G(s) = \frac{K(s+1)}{s^3+ps^2+2s+1}$ oscillates with frequency 2 rad/ sec . Find values of K and p

b) Sketch the root locus of the system whose open loop transfer function is [8M]

G(s)=$\frac{k}{s(s+1)(s+3)}$. find the value of k for damping ratio of 0.5

6 Consider a unity feedback system having an open loop transfer function [16M]

$G(S) = \frac{K}{S(1+0.5S)(1+4S)}$ sketch the Bode plot and determine the value of 'k' so that gain margin is 20 db and phase margin is 30^0.

7 a) What are the advantages of state model representation? [4M]

b) $[X]=\begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}[x]+\begin{bmatrix} 0 \\ 1 \end{bmatrix}u$, $y = [1 \quad 0]\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ with initial conditions [12M]

$x(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Calculate STM, complete solution x(t) and y(t).

Note: SET-3 needs ordinary graph sheets and semi-log graph sheets.

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Code No: RT31043 **R13** SET - 4

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2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Normal and semi & polar graph sheet are the supplied)

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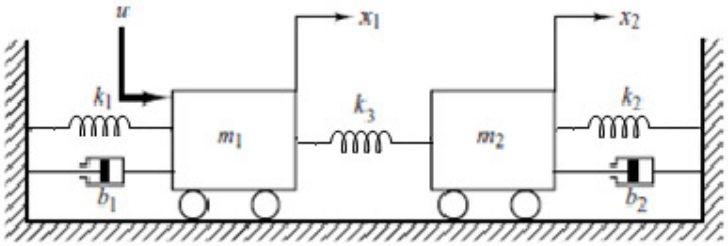
PART –A

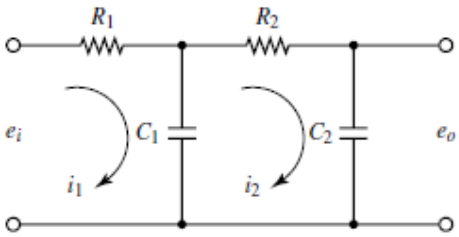
1 a) Explain about the negative feed back of loop with examples. [3M]
b) Derive the transfer function of field controlled DC servo motor. [4M]
c) What are Standard test signals? [4M]
d) Explain about Routh's stability criterion. [3M]
e) What is Bode plot? Draw the Bode plot of G(s)=1/(1+ST) [4M]
f) Explain about Lead-Lag compensator. [4M]

PART -B

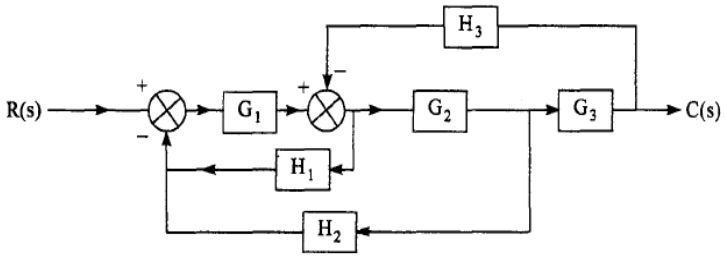
2 a) Obtain transfer function $X_1(s)/U(s)$. [8M]



b) Obtain the transfer function *E*o(s)/*E*i(s). (Capacitors *C*1 and *C*2 are not charged initially.) [8M]



3 a) Derive the transfer function C(s)/R(s) for the following diagram by using block diagram reduction technique. [8M]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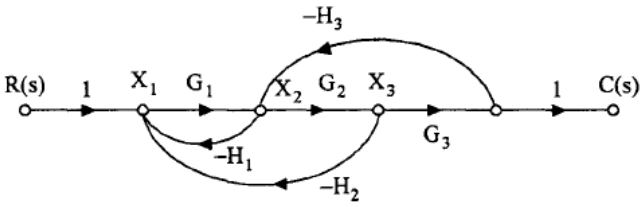
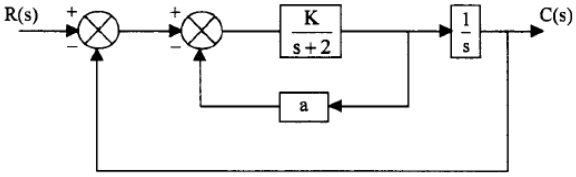
b) Find transfer function C(s)/R(s). [8M]



4 a) Explain about PIDl controller. [8M]

b) Determine the values of 'K' and 'a' such that the damping factor is 0.6 and a settling time of 1.67 sec. Also find the step response of the system. [8M]



5 Sketch the root locus diagram for the following open loop transfer function: [16M]

$$G(S) = \frac{K}{S(S+4)(S^2+4S+20)}$$

6 a) Draw the bode plot of $G(s)H(s) = \frac{250}{s(2.5+s)(10+s)}$ .Find Gain Margin & Phase Margin. [8M]

b) Draw the Nyquist plot of $G(s)H(s) = \frac{k}{s(2+s)(10+s)}$ and there from determine range of K for stability using Nyquist Criterion. [8M]

7 a) Obtain the state model of the system whose transfer function is given as [6M]

$$\frac{y(s)}{u(s)} = \frac{10}{(s^3+4s^2+2s+1)}$$

b) Define controllability and observability. Find controllability and observability of the given system [10M]

$$\begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} 2 & -2 & 3 \\ 1 & 1 & 1 \\ 1 & 3 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 11 \\ 1 \\ -14 \end{bmatrix} [u] \quad ; Y = [-3 \quad 5 \quad -2] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Note: SET-4 needs ordinary graph sheets and semi-log graph sheets.

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