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

III B. Tech I Semester Supplementary Examinations, May-2017
CONTROL SYSTEMS
(Common to Electronics and Communication Engineering and Electronics and Instrumentation Engineering)

Time: 3 hours Maximum. 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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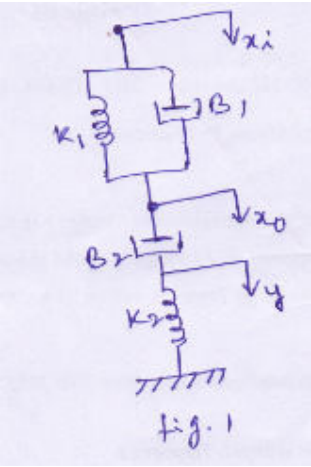
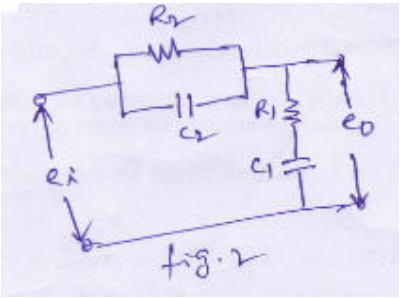
PART –A

1 a) Write the force balance equation of ideal dashpot. [3M]
b) What are the characteristics of servomotors? [4M]
c) Mention two advantages of generalized error constants over static error constants. [4M]
d) What is routh stability criterion? [4M]
e) What are the advantages of bode plot? [3M]
f) Define the controllability and obsevability. [4M]

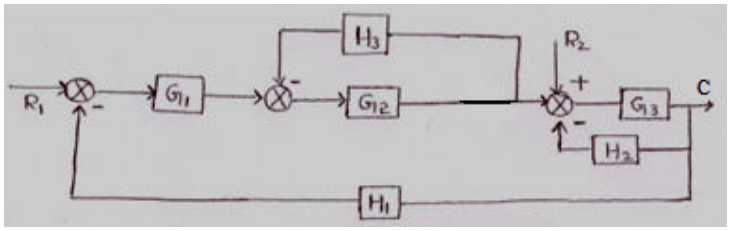
PART -B

2 a) Define control systems. Explain the differences between closed looped and open looped system with a suitable example. [4M]
b) Obtain the transfer function of the mechanical system shown in figure. Also obtain the transfer function of figure. 2. Show that the transfer functions of the two systems are of identical form and thus these are analogous systems. [12M]





3 a) Using block diagram reduction technique, find closed loop transfer function of the system whose block diagram is shown in figure below (i) when R1=0 and (ii) when R2=0. [8M]



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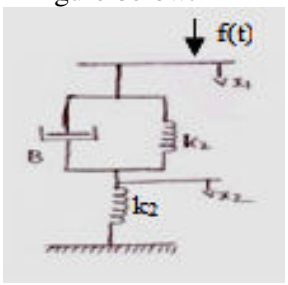
3 b) Derive the transfer function of field controlled DC Servo motor. [8M]

4 a) The open loop transfer function of a servo system with unity feedback is [3M] $G(S) = \frac{10}{S(0.1S+1)}$. Evaluate the static error constant of the system. Obtain the steady state error of the system when subjected to an input given by the polynomial $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$.

b) A unity feedback control system has its open loop transfer function given by 8M] $G(S) = \frac{(4S+1)}{4S^2}$ Determine an expression for the time response when the system is subjected to (**i**) Unit impulse input function and (**ii**) Unit step input function.

c) Draw the electrical analogous circuit (use f-v analogy) and derive their transfer function for the system shown in figure below. [5M]



5 a) Sketch the root locus plot for the open loop transfer function given below [10M] $G(S)H(S) = \frac{K(S^2+4)}{S(S+2)}$. Calculate the value of K at

i) break away point and **ii**) S= -0.7 +j0.9.

b) Determine the value of K such that the roots of the characteristics equation given below lie to the left of line S= -1 [6M]

$S^3 + 10S^2 + 18S + K = 0$.

6 a) Sketch the Bode plot for the open loop transfer function for the unity feedback system given below and assess stability [8M] $G(S) = \frac{50}{(S+1)(s+2)}$.

b) The open loop transfer function of a feedback control system is given by [8M] $G(S)H(S) = \frac{K}{S^2+S-2}$. Plot the Nyquist plot and show that the closed loop system is stable if $K \geq 2$.

7 a) For the system given below obtain total response $\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$ [8M]

where $x_1(0) = 1$, $x_2(0) = 0$ and $u(t) = 1$.

b) Define state transition matrix and explain its properties with examples. [8M]

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III B. Tech I Semester Supplementary Examinations, May - 2016
CONTROL SYSTEMS
(Common to ECE and EIE)

Time: 3 hours Maximum. 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) What are the characteristics of negative feedback? [3M]

b) Compare the AC and DC servomotor. [4M]

c) What is the effect on system performance when a proportional controller is introduced in a system? [4M]

d) What are asymptotes? How will you find the angle of asymptotes? [4M]

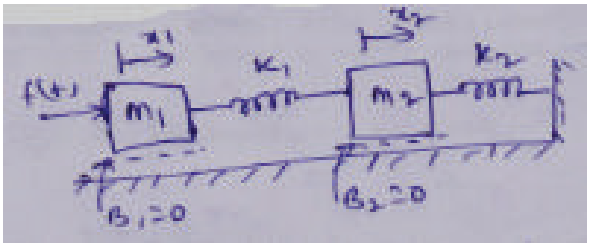
e) What is phase and gain crossover frequency? [3M]

f) Why compensation is necessary in feedback control system. [4M]

PART -B

2 a) Define open loop and closed loop systems. Mention their merits and demerits. [8M]

b) Draw the free body diagram and write the differential equations describing the dynamics of the system shown in below figure and obtain the transfer function $\frac{X_2(s)}{F(s)}$ [8M]



3 a) For the system represented by the given equations find the transfer function x_5/x_1 by the help of signal flow graph technique. [8M]

$x_2 = a_{12}x_1 + a_3 x_3 + a_{42} x_4 + a_{52} x_5$

$x_3 = a_{23} x_2$

$x_4 = a_{34} x_3 + a_{44} x_4$

$x_5 = a_{35} x_3 + a_{45} x_4$

Where x_1 is input variable and x_5 is output variable.

b) Derive the transfer function of field controlled AC Servo motor. [8M]

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4 a) What is meant by step input, ramp input and impulse input? How do you represent them graphically? [6M]

b) The open loop transfer function of a unity feedback system is given by [12M]

$G(s)\frac{K}{s(1+Ts)}$ Where K and T are positive constant. By what factor should the amplifier gain K be reduced so that the peak overshoot of unit step input of the system is reduced from 75% to 25%.

5 a) Draw the root lows plot for a system having open loop transfer functions is [8M]

$G(s) = \frac{K}{S(S+1)(s+5)}$.

b) Using Routh criterion investigate the stability of a unity feedback control system whose open loop transfer function is given by. [8M]

$$G(S) = \frac{e^{-sT}}{S(S+2)}$$

6 a) Construct Bode plot for the system whose open loop transfer function is given below and determine (i) the gain margin (ii) the phase margin and (iii) the closed loop stability $G(S)H(S) = \frac{4}{S(1+0.5S)(1+0.08S)}$. [8M]

b) Sketch Nyquist plot whose open loop transfer function is given by [8M]

$G(S)H(S) = \frac{KS^2}{S^3+4S+4}$ and examine closed loop stability in terms of parameter K.

7 a) The open loop transfer function of a unity feedback control system is given by [8M]

$G(S) = \frac{K}{S(1+0.2S)}$ design a suitable compensator such that the system will have K_v=10 and P.M = 50^0.

b) The transfer function of a control system is given by [8M]

$\frac{Y(S)}{U(S)} = \frac{S+2}{S^3+9S^2+26S+24}$ check for controllability and observability.

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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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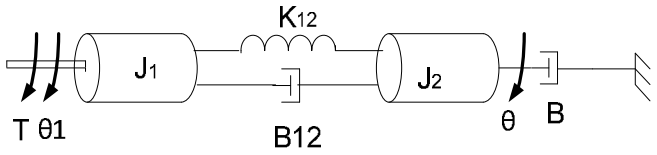
PART –A

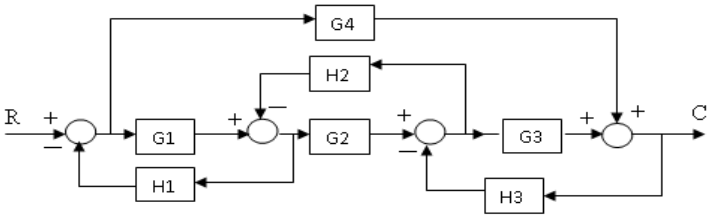
1 a) Define a control system. Explain about open-loop and closed-loop control systems. [3M]
b) Derive the transfer function of Armature controlled DC servo motor. [4M]
c) Define the error constants Kp, Kv and Ka. [4M]
d) Explain about the effects of adding zeroes to G(s)H(s) on the root loci. [3M]
e)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

$G(S)H(S) = \dfrac{K}{S(S+4)(S+6)}$ 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 : $G(S) = \dfrac{10}{S(S+1)}$ [8M]

b) Draw the polar plot of $G(S)\,H(S) = \dfrac{K}{S(S+3)(S+5)}$ 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

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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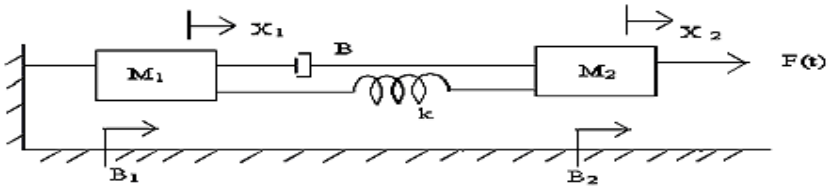
PART –A

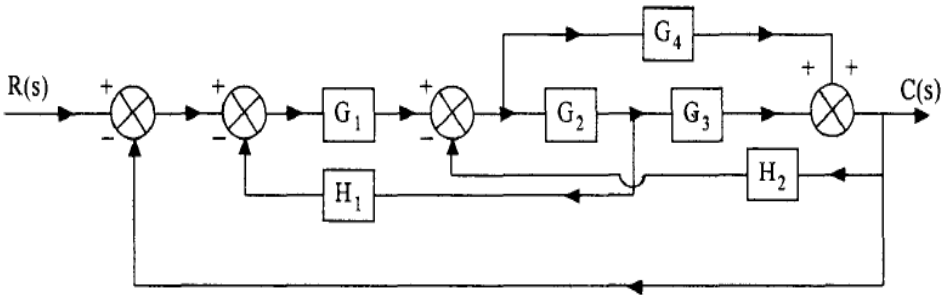
1 a) Write the advantages and disadvantages of open-loop and closed-loop control systems. [3M]
b) Explain about Mason's gain formula. [4M]
c) Write short notes on steady state error. [4M]
d) What are effects of adding poles to G(s)H(s) on the root loci ? [3M]
e) Explain about Phase Margin and Gain Margin.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

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

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

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

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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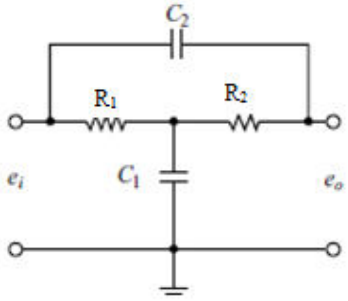
PART –A

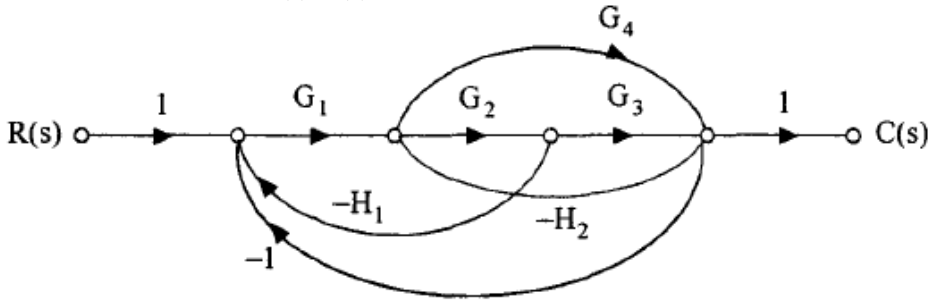
1 a) Compare the open-loop and closed-loop control systems. [3M]
b) Derive the transfer function for AC servomotor. [4M]
c) Derive the response of a standard first order system for unit step input. [4M]
d) What are limitations of Routh's stability criterion? [3M]
e) What is polar plot? Draw the polar 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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Code No: RT31043 **R13** SET - 3

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

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)**
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3. Answer any **THREE** Questions from **Part-B**
(Normal and semi & polar graph sheet are the supplied)

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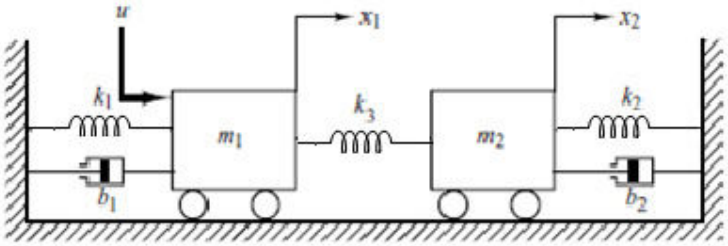
PART –A

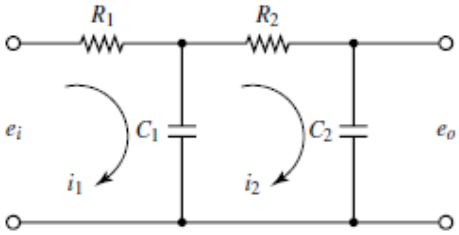
1 a) Explain about the negative feed back of loop with examples. [3M]
b) Derive the transfer function of field controlled DC servo motor. [4M]
c) What are Standard test signals? [4M]
d) Explain about Routh's stability criterion. [3M]
e) What is Bode plot? Draw the Bode plot of G(s)=1/(1+ST) [4M]
f) Explain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

PART -B

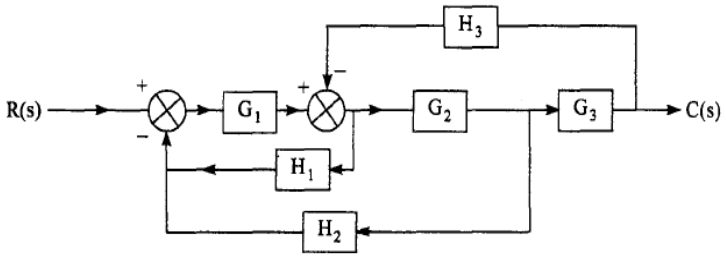
2 a) Obtain transfer function $X_1(s)/U(s)$. [8M]



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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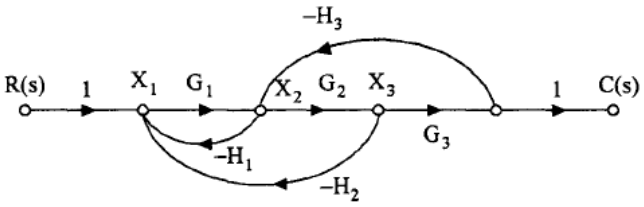
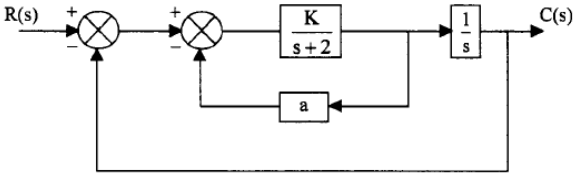
b) Find transfer function C(s)/R(s). [8M]



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]

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}2 & -2 & 3\\ 1 & 1 & 1\\ 1 & 3 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}11\\ 1\\ -14\end{bmatrix}[u] \quad ; \quad Y=\begin{bmatrix}-3 & 5 & -2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}$$

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

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

III B. Tech I Semester Regular Examinations, November - 2015

CONTROL SYSTEMS

(Common 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 sheets are to be supplied)

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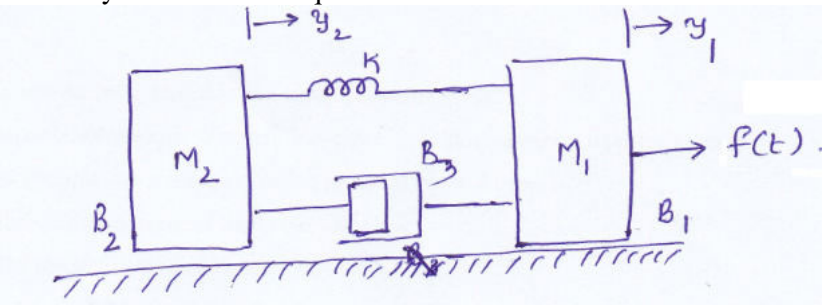
PART –A

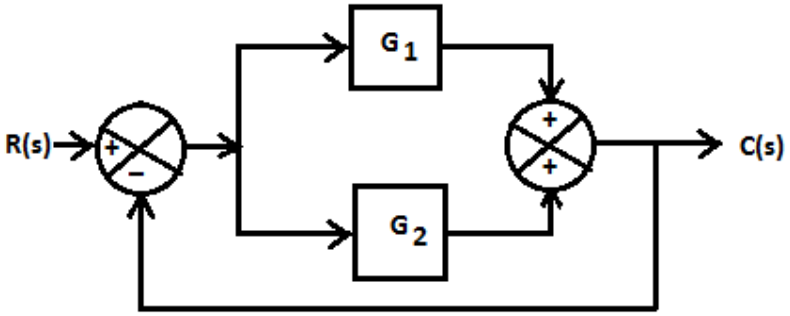
1	a)	What are the basic elements of a control system?	[3M]
	b)	Explain the advantages of signal flow graph over block diagram representation.	[4M]
	c)	Draw the unit step response of a first order system and explain.	[4M]
	d)	Explain the advantages of root locus technique.	[4M]
	e)	Define resonant peak and bandwidth.	[4M]
	f)	What is meant by Diagonalization?	[3M]

PART -B

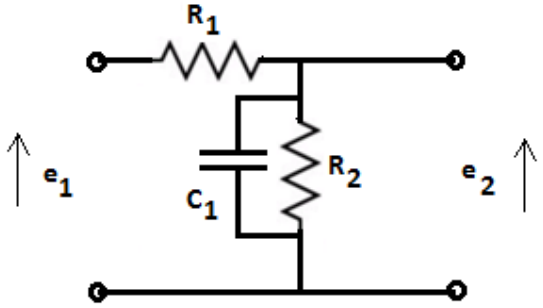
2	a)	Write short notes on controlled variable and manipulated variable.	[4M]
	b)	Write the force equations of the linear translational system shown in figure. Draw the equivalent electrical network using force-voltage Analogy, with the help of necessary mathematical equations.	[8M]



	c)	What is meant by unity feedback control systems? Explain.	[4M]
3	a)	Draw the signal flow graph for the block diagram below and then obtain the transfer function C(s)/R(s) using Mason's gain formula.	[8M]



b) Obtain the transfer function $E_2(s)/E_1(s)$ for the electrical circuit below by representing the circuit into a block diagram and using block diagram algebra. [8M]



4 a) Explain the effect of PID control action on the performance of a second order system [6M]

b) Determine the step, ramp and parabolic error constants of the following unity feedback control system whose open loop transfer function is given by [10M]

$$G(s) = \frac{500}{(1+5s)\ (1+10s)}.$$

5 a) Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis $s^4 + s^3 + 3s^2 + 2s + 5 = 0$. [7M]

b) Find the angles of departure and arrival for all complex poles and zeros of the open loop transfer function of $G(s)H(s) = \frac{K(s^2+3s+5)}{s(s^2+4)}, K > 0$. [9M]

6 a) Find resonant peak, resonant frequency and bandwidth of the unity feedback system whose open loop transfer function is as follows: $G(s) = \frac{0.5}{(s^2+3s+2)}$. [8M]

b) The characteristic equation of a linear control system is given below: [8M]

$$s^2 + 3s + 2 + K = 0\ .$$

Using Nyquist Stability Criterion, determine the range of K for the system to be stable.

7 a) Draw the electrical circuit diagram that represents the Lead-Lag Compensator and explain in detail. [8M]

b) Determine the state and output equations in vector matrix form for the system whose transfer function is given by $G(s) = \frac{(s+3)}{s(s^2+3s+2)}$. [8M]

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

III B. Tech I Semester Regular Examinations, November - 2015

CONTROL SYSTEMS

(Common 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 sheets are to be supplied)

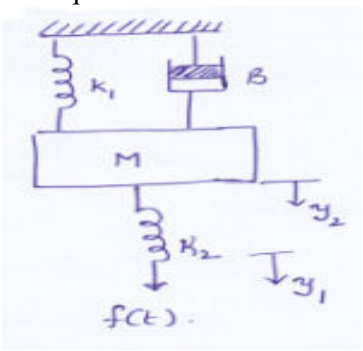
*****

PART –A

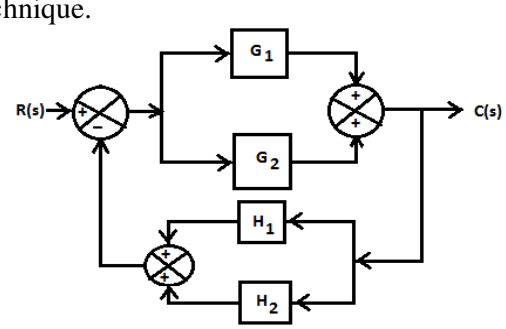
1	a)	What is meant by open loop control system?	[3M]
	b)	Describe the Mason's gain formula.	[4M]
	c)	Draw the unit impulse response of a first order system and explain.	[4M]
	d)	Define absolute stability and relative stability.	[4M]
	e)	Define resonant frequency and cut off rate.	[4M]
	f)	What is meant by Observability?	[3M]

PART -B

2	a)	Write short notes on feedback control.	[4M]
	b)	Write the force equations of the linear translational system shown in the figure below. Draw the equivalent electrical network using force- voltage analogy, with the help of necessary mathematical equations.	[8M]



	c)	Draw the block diagram of a control system and explain its operation.	[4M]
3	a)	Obtain the transfer function C(s)/R(s) for the block diagram below using block diagram reduction technique.	[8M]



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b) Derive the transfer function of Synchro Pair. [8M]

4 a) Explain the effect of Proportional plus Derivative Control (PD) action on the performance of a second order system. [6M]

b) Determine the step, ramp and parabolic error constants of the following unity feedback control system whose open loop transfer function is given by [10M]

$$G(s) = \frac{1000}{(1+2s)(1+0.5s)}.$$

5 a) Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis $3s^4 + 7s^3 + 2s^2 + s + 8 = 0$. [7M]

b) Find the angles of departure and arrival for all complex poles and zeros of the open loop transfer function of $G(s)H(s) = \frac{K(s^2+s+2)}{s(s^2+9)}, K > 0$. [9M]

6 a) Find resonant peak, resonant frequency and bandwidth of the unity feedback system whose open loop transfer function is $G(s) = \frac{1}{(s^2+6s+5)}$. [8M]

b) The forward path transfer function of a unity feedback system is given by $G(s) = \frac{K}{(s+1)(s+2)}$. Using Bode diagram, determine the value of K so that the phase margin of the system is 45°. [8M]

7 a) Draw the electrical circuit diagram that represents the Lag-Lead Compensator and explain in detail. [8M]

b) Determine the state and output equations in vector matrix form for the system whose transfer function is given by $G(s) = \frac{(s+2)}{s(s^2+4s+3)}$. [8M]

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

III B. Tech I Semester Regular Examinations, November - 2015
CONTROL SYSTEMS
(Common 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 sheets are to be supplied)

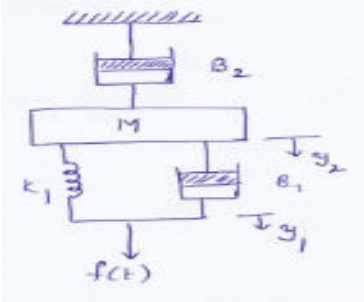
*****

PART –A

1 a) What is meant by closed loop control system? [3M]
b) What are the advantages of block diagram representation of a system? [4M]
c) Define Delay time and rise time. [4M]
d) Compare the stability of open loop and closed loop systems. [4M]
e) Define gain and phase margins. [4M]
f) What is meant by controllability? [3M]

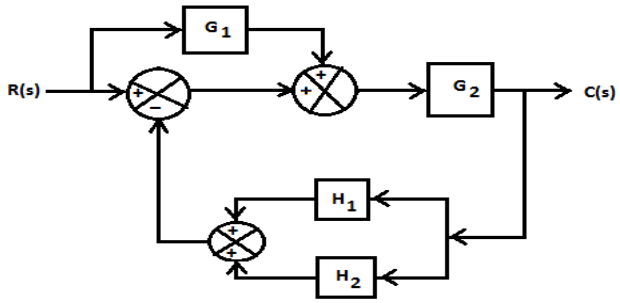
PART -B

2 a) Classify the control systems in detail. [4M]
b) Write the force equations of the linear translational system shown in the figure below. Draw the equivalent electrical network using force-voltage analogy, with the help of necessary mathematical equations. [8M]



c) Explain the effects of feedback on the system performance. [4M]

3 a) Using block diagram reduction techniques obtain the transfer function C(s)/R(s) for the block diagram below. [8M]



b) Derive the transfer function of AC servo motor. [8M]

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4 a) Explain the effect of Proportional plus Integral Control (PI) action on the performance of a second order system. [6M]

b) Calculate the steady state errors due to a unit step input, a unit ramp input and a unit parabolic input for a unity feedback control system whose open loop transfer function is $G(s) = \frac{1}{(s^2 + 3s + 1)}$. [10M]

5 a) Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis $s^3 + 2s^2 + s + 8 = 0$. [7M]

b) Find the angles of asymptotes and the intersect of the asymptotes of the root locus of the following equation when K varies from $-\infty$ *to* ∞ [9M]

$$s^3 + 5s^2 + s + K(s+1) = 0.$$

6 a) The forward path transfer function of a unity feedback system is given by $G(s) = \frac{K}{(s+3)^2}$. Using Nyquist Stability Criterion, determine the range of K for the closed loop system to be stable. [8M]

b) The forward path transfer function of a unity feedback system is given by [8M]

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

Using Bode diagram, determine the value of K so that the gain margin of the system is 20 dB.

7 a) Draw the electrical circuit diagram that represents the Lead Compensator and explain in detail. [8M]

b) The state equation of a linear time invariant system is represented by [8M]

$$\frac{d\,x(t)}{dt} = A\,x(t) + Bu(t)$$

$A = \begin{bmatrix} 3 & 0 \\ 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Find the state transition matrix and the Eigen values of A.

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

III B. Tech I Semester Regular Examinations, November - 2015
CONTROL SYSTEMS
(Common 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 sheets are to be supplied)

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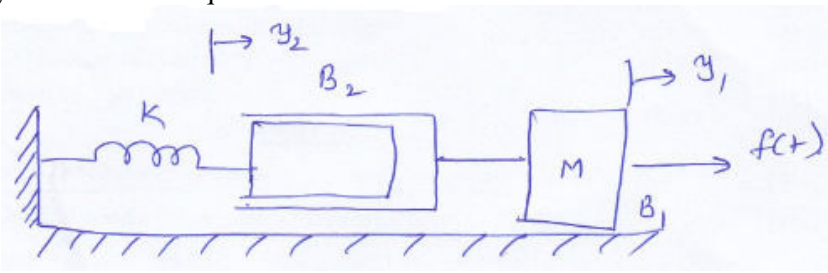
PART –A

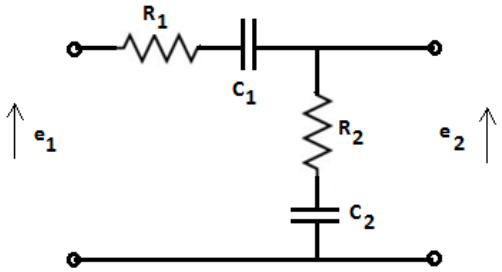
1	a)	What are the advantages of Mathematical Model?	[3M]
	b)	What are the advantages of transfer function representation of a system?	[4M]
	c)	Define maximum peak overshoot and settling time.	[4M]
	d)	Define qualitative stability and conditional stability.	[4M]
	e)	Explain the advantages of Polar plots.	[4M]
	f)	What does mean by state model?	[3M]

PART -B

2	a)	Compare the performances of closed loop and open loop control systems.	[4M]
	b)	Write the force equations of the linear translational system shown in the figure below. Draw the equivalent electrical network using force-voltage analogy, with the help of necessary mathematical equations.	[8M]



	c)	Derive the relationship that shows the effect of feedback on the overall gain of the system.	[4M]
3	a)	Obtain the transfer function $E_2(s)/E_1(s)$ for the electrical circuit below, by converting the circuit into a block diagram and then using block diagram reduction technique.	[8M]



	b)	Derive the transfer function of DC servo motor.	[8M]

4 a) Explain the effect of Proportional Control action on the performance of a second order system. [6M]

b) Calculate the steady state errors due to a unit step input, a unit ramp input and a unit parabolic input for a unity feedback control system whose open loop transfer function is $G(s) = \frac{1}{s^2(s+6)}$. [10M]

5 a) Using Routh-Hurwitz criterion, determine the stability of the closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half s-plane and on the imaginary axis $s^3 + 3s^2 + 6s + 1 = 0$. [7M]

b) Find the angles of asymptotes and the intersect of the asymptotes of the root locus of the following equation when K varies from $-\infty$ *to* ∞ [9M]

$$(1+K)s^3 + (2+3K)s^2 + s(3-K) - 3K = 0.$$

6 a) The loop transfer function of a system is given by $G(s)\,H(s) = \frac{1}{s^3(s+2)}$. Draw the polar plot. [8M]

b) The loop transfer function of a system is given by $G(s)\,H(s) = \frac{25}{(s+2)^2}$. Using Bode diagram, find gain and phase margins of the system. [8M]

7 a) Draw the electrical circuit diagram that represents the Lag Compensator and explain in detail. [8M]

b) The state equation of a linear time invariant system is represented by [8M]

$\frac{d\,x(t)}{dt} = A\,x(t) + Bu(t)$

$A = \begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Find the state transition matrix and the Eigen values of A

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