II B. Tech II Semester Supplementary Examinations, Nov/Dec-2016
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) Why negative feedback is preferred in control systems. (3M)
b) What do you mean by a signal flow graph? (3M)
c) Name the standard test signals used in control systems and why are they needed. (3M)
d) What do you mean by zero state response? (2M)
e) Define the Phase cross over frequency. (2M)
f) What is the requirement of gain margin and phase margin for a stable system? (3M)
g) What is the basis for the selection of a particular compensator? (3M)
h) What do you mean by decomposition of a transfer function? (3M)

PART-B

2. a) Compare in detail about Block diagram and signal flow graph methods. (8M)
b) Derive the transfer of AC servo motor. (8M)

3. a) Explain the time response of under damped 2^{nd} order system along with its transient response specifications (8M)
b) The open – loop transfer function of a unity feedback system is (8M)

G(s) = $\frac{8}{s(s+6)}$ Determine the nature of response of the closed – loop system for a unit – step input. Also determine the rise time, peak time, peak over shoot and settling time.

4. A unity feedback control system is characterized by the open loop transfer function (16M)

G(s) = $\frac{K(s+11)}{s(s+5)(s+9)}$ Using the Routh criterion

i) Calculate the range of values of K for the system to be stable. ii) What is the marginal value of K for stability? Determine the frequency of oscillations if any iii) Check for K = 1, all the roots of the characteristic equation of the above system have the damping factor greater than 0.5.

5. a) Explain the procedure to determine the gain margin and phase margin of a system from its Bode plot? (8M)
b) A feedback system has G(s) H(s) = $\frac{100(s+4)}{s(s+0.5)(s+10)}$ Draw the Bode plot and comment on stability. (8M)
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6. a) Derive the expression for the transfer function of a lead compensator. (10M)
   b) What are the effects of phase – lead compensation? (6M)

7. Write short notes on the following: (16M)
   (a) Controllability and observability
   (b) State transition matrix
   (c) Diagonalization

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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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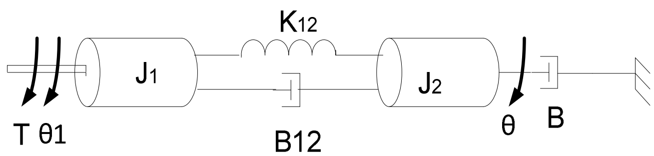
PART –A

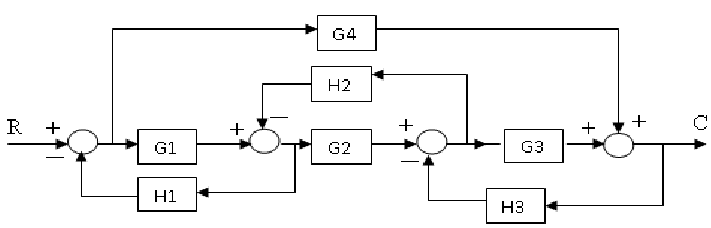
1 a) Define a control system. Explain about open-loop and closed-loop control systems. [3M]
b) Derive the transfer function of Armature controlled DC servo motor. [4M]
c) Define the error constants Kp, Kv and Ka. [4M]
d) Explain about the effects of adding zeroes to G(s)H(s) on the root loci. [3M]
e) 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 $G(S)=\frac{K}{S(S+10)}$. 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. [8M]
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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]

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

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

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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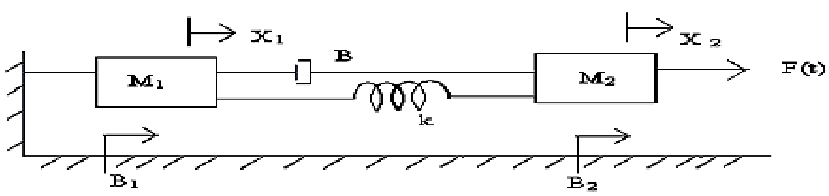
PART –A

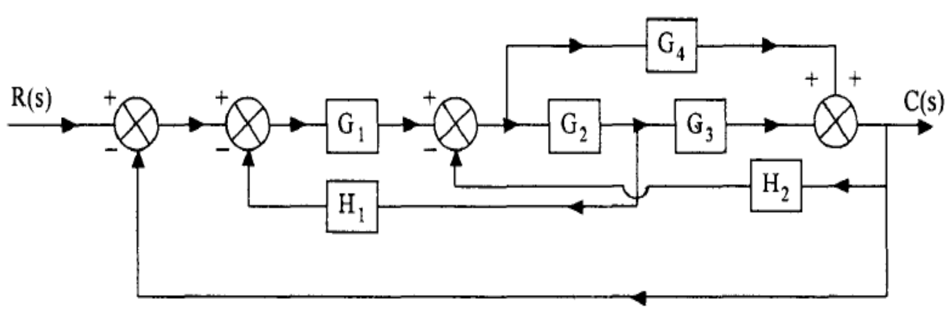
1 a) Write the advantages and disadvantages of open-loop and closed-loop control systems. [3M]
b) Explain about Mason's gain formula. [4M]
c) Write short notes on steady state error. [4M]
d) What are effects of adding poles to G(s)H(s) on the root loci ? [3M]
e) Explain about Phase Margin and Gain Margin. [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 $G(s)H(s)=\frac{k}{s(s+2)(s+4)}$. find the value of k for damping ratio of 0.5 [8M]

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

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]

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

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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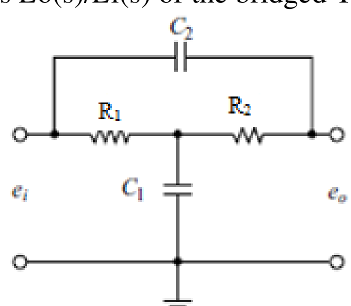
PART –A

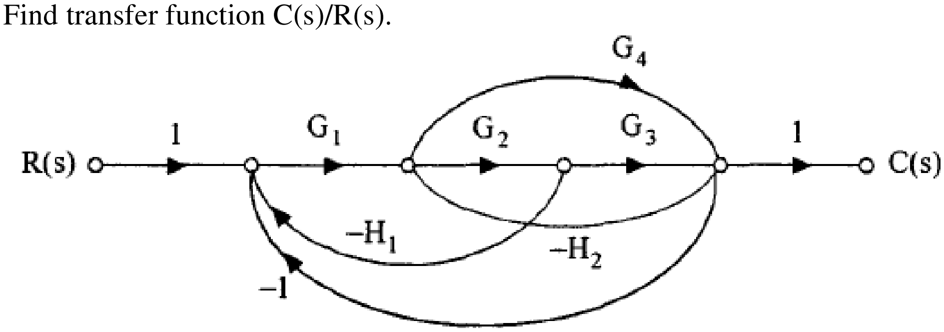
1 a) Compare the open-loop and closed-loop control systems. [3M]
b) Derive the transfer function for AC servomotor. [4M]
c) Derive the response of a standard first order system for unit step input. [4M]
d) What are limitations of Routh's stability criterion? [3M]
e) What is polar plot? Draw the polar 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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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 $G(s) = \frac{K(s+1)}{s^3+ps^2+2s+1}$ oscillates with frequency 2 rad/ sec . Find values of K and p [8M]

b) Sketch the root locus of the system whose open loop transfer function is $G(s)=\frac{k}{s(s+1)(s+3)}$. find the value of k for damping ratio of 0.5 [8M]

6 Consider a unity feedback system having an open loop transfer function $G(S) = \frac{K}{S(1+0.5S)(1+4S)}$ sketch the Bode plot and determine the value of 'k' so that gain margin is 20 db and phase margin is 30^0. [16M]

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

b) $[\dot{X}] = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}[x] + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u$, $y = [1 \quad 0]\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ with initial conditions $x(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Calculate STM, complete solution x(t) and y(t). [12M]

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)**
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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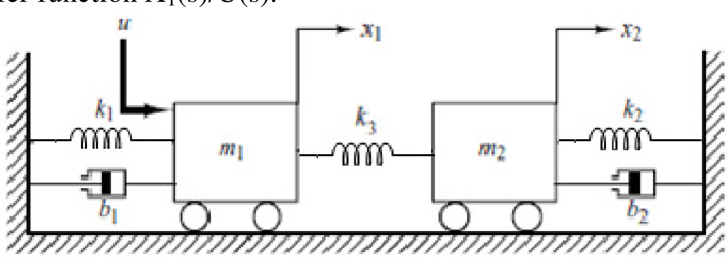
PART –A

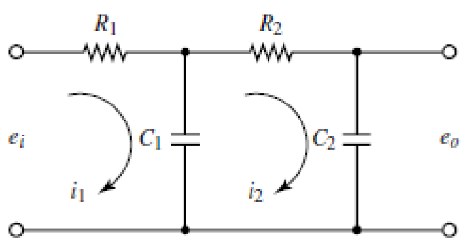
1 a) Explain about the negative feed back of loop with examples. [3M]
b) Derive the transfer function of field controlled DC servo motor. [4M]
c) What are Standard test signals? [4M]
d) Explain about Routh's stability criterion. [3M]
e) What is Bode plot? Draw the Bode plot of G(s)=1/(1+ST) [4M]
f) Explain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

PART -B

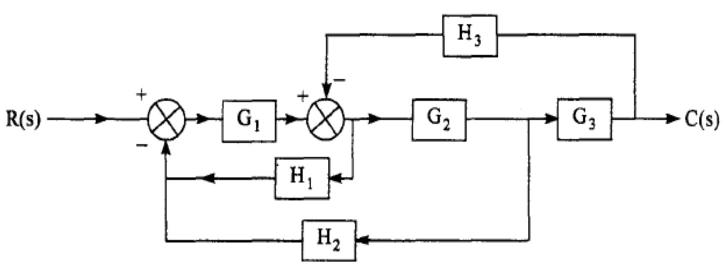
2 a) Obtain transfer function $X_1(s)/U(s)$. [8M]



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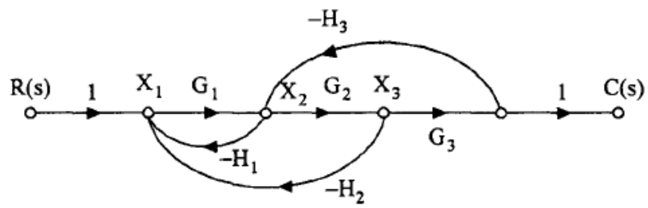
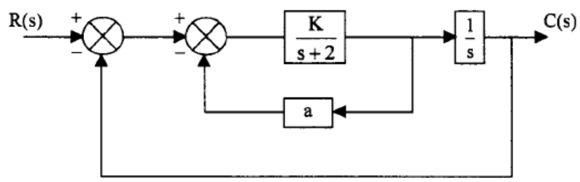
b) Find transfer function C(s)/R(s). [8M]



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]

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

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

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Code No: RT22026 **R13** SET - 1

II B. Tech II Semester Regular Examinations, April/May – 2016
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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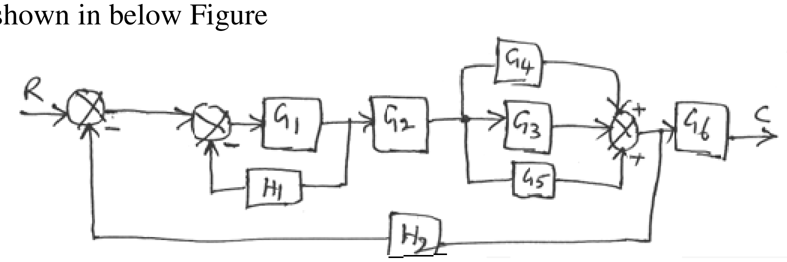
PART –A

1. a) State and explain the Mason's gain formula
b) Define steady state error
c) What is the necessary condition that the characteristic equation of a feedback system satisfies the BIBO stability?
d) State the Nyquist Stability criterion
e) Why bode plots are commonly used in the frequency domain design
f) What are the properties of STM

PART -B

2. a) Explain the reduction of parameter variation by feedback.
b) Using block diagram reduction technique finds the transfer function for the system shown in below Figure



3. a) What is meant by step, ramp, parabolic and impulse inputs
b) The open-loop transfer function of a control system with unity feedback is

$$G(s) = \frac{150}{s(1+0.25s)}$$

i) Evaluate the error series for the system
ii) Determine the steady state error for an input

$$r(t) = (1+t^2)\,u(t)$$

4. a) Explain the construction rules for root locus technique
b) Test the stability of the system with the following characteristic equation by Routh's test $s^6 + 2s^5 + 8s^4 + 20s^2 + 16s + 16 = 0$
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5. a) Explain frequency domain specifications.
   b) A unity feedback control system has an open loop transfer function given by G(s) H(s) = $\frac{100}{s(s+5)(s+2)}$ .Draw Nyquist diagram and determine stability.

6. For the given open loop transfer function, $G(s) = \frac{K}{s(s+4)(s+6)}$.

   Design suitable lead compensation so that phase margin is $\geq 40^o$ and velocity error constant, $K_v \geq 20$.

7. a) List out the advantages of state space techniques
   b) Determine the state model of the system for the following transfer function

$$\frac{Y(s)}{U(s)} = \frac{2s^2+s+5}{s^3+6s^2+11s+4}$$

Code No: RT22026 **R13** SET - 2

II B. Tech II Semester Regular Examinations, April/May – 2016
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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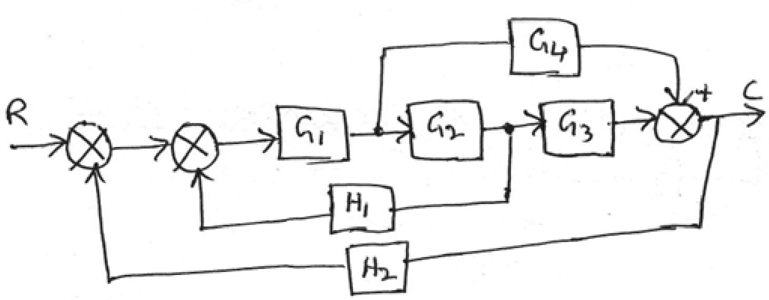
PART –A

1. a) How the control systems are classified
   b) Define steady state response
   c) When does the procedure for making the Routh array gets terminated
   d) What is meant by asymptotes
   e) What is the need of compensator
   f) What are the merits of state variable technique

PART –B

2. a) What are the requirements for good servomotor
   b) Find the gain of the system using signal flow graph approach for a given block diagram as shown in Figure below.



3. a) Explain time domain specification
   b) For a negative feedback control system $G(s) = \frac{10}{s(0.45+1)}$ and $H(s) = \frac{5}{s+4}$. Using generalized error series determine the steady state error of the system when the input applied is r (t) = $1+3t+4t^2$.
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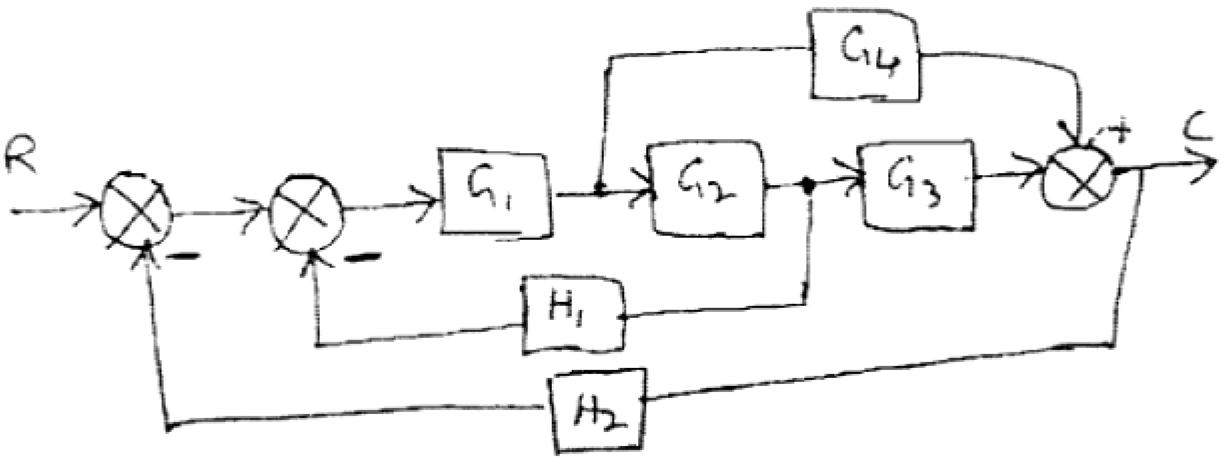

R
G4
+
C
G1
G2
G3
-
-
H1
H2

4. a) Define and derive the breakaway point on the root locus
   b) Determine the number of roots of a given polynomial with real parts between zero and –1, $8s^2 + 44s^4 + 126s^3 + 219s^2 + 258s + 85 = 0$

5. a) Derive the relation between phase margin and damping ratio
   b) Sketch the polar plot for a given open loop transfer function.

$$G(s) = \frac{10}{s(s+1)(s+3)}$$

6. A unit feedback system has an open loop transfer function

$G(s) = \dfrac{K}{s(s+1)(0.2s+1)}$. Design a phase lag compensator to meet the following specifications.

Velocity error constant = 8

Phase margin $\geq 40^o$

7. a) Explain the concepts of state, state variables and state model
   b) Determine the state model of the system characterized by the differential equation $(s^4 + 2s^2 + 8s^3 + 4s + 3)\ Y(s) = 10\ U(s)$

II B. Tech II Semester Regular Examinations, April/May – 2016
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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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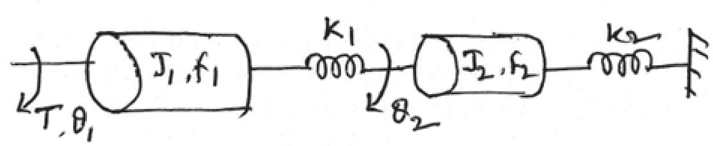
PART –A

1. a) Illustrate between open loop and closed loop control systems
   b) What are the standard test signals used in time domain analysis
   c) What is the effect of addition of poles on root locus
   d) What are the merits of frequency domain analysis
   e) What are the different types of electrical compensators
   f) Define the concept of state in state space analysis.

PART -B

2. a) Describe the AC servo motor and draw its torque vs speed characteristics
   b) Find the transfer function $\frac{\theta_2(s)}{T(s)}$ for a given rotational mechanical system is as shown in below figure



3. a) Define the steady state error and error constants of different types of inputs
   b) A unity feedback system has a forward path transfer function $G(s) = \frac{9}{s(s+1)}$. Find the value of damping ratio, undamped natural frequency of the system, percentage over shoot, peak time and settling time.

4. a) Explain the special cases in Rouths stability criterion
   b) Sketch the root locus for the characteristic equation is
   $s(s+1)(s+2) + k(s + 1.5) = 0$
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5. a) Derive the correlation between time domain and frequency domain specifications
   b) Sketch the Bode plot and determine the Gain margin and phase margin

   For the transfer function is given, $G(s) == \frac{10}{s(1+0.4s)(1+0.1s)}$

6. A unity feedback system has an open loop transfer function

   $G(s) = \frac{K}{s(s+3)(s+10)}$ design a suitable lag compensation so that phase margin is $\geq 45^0$ and velocity error constant, $K_v \geq 15$

7. a) State and explain the concepts of Controllability and Observability.
   b) Given $G(s) = \frac{2}{s^2+5s+6}$, obtain the state space model of the system in the diagonal canonical form.

Code No: RT22026 **R13** SET - 4

II B. Tech II Semester Regular Examinations, April/May – 2016
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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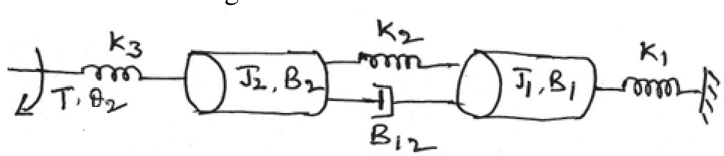
PART –A

1. a) Define the closed loop control system with diagram
b) What is the different between type and order of a system
c) What are the merits of root locus
d) What are the frequency domain specification
e) What is the need of lead-lag compensator
f) What is controllability

PART –B

2. a) Explain the construction and operating principle of synchro transmitter with neat diagrams
b) Derive the transfer function $\frac{\theta_2(s)}{T(s)}$ for the given rotational mechanical system shown in below figure



3. a) Derive the generalized error constants
b) A unity feedback control system has a loop transfer function, G(s) = $\frac{10}{s(s+2)}$. Find the rise time, percentage overshoot, peak time and settling time for a step input of 12 units.

4. a) What are the necessary and sufficient conditions of stability for linear time invariant systems?
b) The open loop transfer function of a unity feedback control system is given by G(s) = $\frac{k}{s(s+3)^2}$. Sketch the root locus plot of the closed loop system for positive values of k and there from determine the value of k that would make the system stable.
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5. a) Discuss the calculation of gain crossover frequency and phase crossover frequency with respective to the polar plots

b) Determine the resonant frequency ω_r, resonant peak M_P and bandwidth for the system whose transfer function is

$$G(j\omega)= \frac{5}{5+j2\omega+(j\omega)^2}$$

6. Consider the open loop transfer function with unit feedback system,

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

Design the lead-lag compensator so that

a) Velocity error constant K_v is 5 sec^{-1}

b) Phase margin not greater than 40^o

c) Gain margin not greater than 10 db

7. a) State and prove the properties of STM

b) Reduce the matrix A to diagonal matrix, $A = \begin{bmatrix} 3 & -2 \\ -1 & 2 \end{bmatrix}$

Code No: RT22026 **R13** SET - 1

II B. Tech II Semester Supplementary Examinations, Dec/Jan-2015-16
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) Discuss about open loop system with an example (3M)
b) What is a take off point or branch point? (3M)
c) What does a time constant of a system indicate? (2M)
d) What does the term 'type' of a system indicate? What is its significance? (3M)
e) Define Phase margin. (3M)
f) What are singular points? (3M)
g) What are compensators? (2M)
h) What are the advantages of canonical form? (3M)

PART-B

2. Derive an expression for the transfer function of an armature controlled DC servo motor (16M)

3. a) Derive expressions for the steady state errors of type – 0, type – 1 and type – 2 systems excited by a unit – parabolic input (6M)
b) A system has the following transfer function (10M)
$\frac{C(s)}{R(s)} = \frac{20}{s+15}$ Determine its unit impulse, step and ramp response with zero initial conditions. Sketch their responses

4. a) Explain the Routh's criteria with an example. (8M)
b) A system has $G(s)\,H(s) = \frac{K}{s(s+2)(s+4)(s+8)}$ Where K is positive. (8M)
Determine the range of K for stability.

5. a) List the advantages and limitations of Frequency response methods. (8M)
b) Sketch the polar plot and discuss the stability of the system represented by (8M)
G(s) H(s) = $\frac{K}{s(s+1)(s+5)}$

6. a) Derive the expression for the transfer function of a lag-lead compensator. (8M)
b) Explain the design procedure of lag compensator (8M)

7. Given the system (16M)
$\dot{x}(t) = A\,x(t) + B\,u(t)$, Y(t) = C x(t) Where A = $\begin{bmatrix} 1 & 1 \\ -2 & -3 \end{bmatrix}$, B =$\begin{bmatrix} 0 \\ 1 \end{bmatrix}$, C = [1 0]
Determine the state controllability, output controllability and observability of the system
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Code No: RT22026 **R13** SET - 1

II B. Tech II Semester Regular Examinations, May/June - 2015
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) Define the transfer function in control system.
b) What is signal flow graph?
c) What are the time domain specifications?
d)What is the effect of addition of pole to a transfer function on Root Locus?
e) What is the effect on polar plot if a non-zero pole is added to the transfer function?
f) What are the specifications in frequency domain design are specified.
g) What is meant by state in control system? (3M+3M+3M+4M+3M+3M+3M)

PART-B

2. a) State and explain the Mason's gain formula.
b) Derive the transfer function and develop the block diagram of Armature controlled DC servo motor

3. a) Discuss the effect of PD and PI on performance of a control system.
b) A unity feed back system is characterized by an open loop transfer function G(s)= $\frac{K}{s(s+5)}$.
Determine the gain K so that the system will have a damping factor of 0.7. For this value of K determine the natural frequency of the system. It is subjected to a unity step input. Obtain the closed loop response of the system in time domain.

4. A unity feedback system has an open loop function G (s) = $\frac{k}{s(s^2+3s+10)}$ make a rough sketch of root locus plot by determining the following (i) Centroid, number and angle of asymptotes (ii) angle of departure of root loci from the poles, (iii) Breakaway points if any, (iv) points of intersection with jω axis and (v) maximum value of k for stability
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5. a) Derive the expressions for frequency domain specifications of a second order system.

   b) Given the open loop transfer function of a unity feedback system $G(s) = \dfrac{1}{s(3+s)(1+2s)}$.

   Draw the Bode plot and measure from the plot the frequency at which the magnitude is 0 dB.

6. Consider a unity feedback system with open loop transfer function $G(s)= \dfrac{K}{s(1+s)(2+s)}$,

   design a suitable compensator so that the compensated system has
   $K_v = 10\ sec^{-1}$
   Phase margin = 40^0
   Gain margin $\leq$ 12 db

7. The state equations of the LTIV system are given by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$;

   $y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

   a) Determine the STM
   b) Find the solution for y(t) and
   c) If a unit step is given to the input, what will be the behavior of the output

Code No: RT22026 **R13** SET - 2

II B. Tech II Semester Regular Examinations, May/June - 2015
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) What are the advantages and disadvantages of closed loop control system?
b) How do you reverse the direction of rotation in AC servomotor
c) Draw the time response of second order system and represent the time domain specifications on it
d) What are the advantages of Root Locus?
e) State the Nyquist stability theorem.
f) Write the differences between lead and lag compensator.
g) What are the properties of state transition matrix (4M+2M+4M+2M+2M+4M+4M)

PART-B

2. a) Derive the transfer function of DC servo motor.
b) What do you mean by the sensitivity of the control system and discuss the effect of feedback on sensitivity

3. a) Define the steady state error and error constants of different types of inputs
b) Damping factor and natural frequency of the system are 0.12 and 84.2 rad/sec respectively. Determine the rise time (t_r), peak time (t_p), maximum peak overshoot (mp) and settling time (t_s).

4. Sketch the root locus plot of unity feedback system with an open loop transfer function $G(s) = \frac{K}{s(s+1)(s+5)}$. Find the range of K for the system to have damped oscillatory response. Determine the value of K so that the dominant pair of complex poles of the system has a damping ratio of 0.6. Corresponding to this value of K. Determine the closed loop transfer function in the factored form.

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5. Determine the value of the gain constant K for the system with open loop transfer function $G(s) = \frac{K}{s(1+0.2s)(1+0.01s)}$. So that it has a phase margin of about 35^0. For this value of K, find the new gain margin.

6. Design a phase lag network for a plant with the open loop transfer function $G(s)= \frac{5}{s(1+0.1s)^2}$ to have a phase margin of 45^0. Verify the performance of the compensated system with the specification

7. a) Discuss the concept of controllability and observability with an example.

b) Given the state equation $\dot{X} = AX$, where $A = \begin{bmatrix} -3 & 1 & 0 \\ 0 & -3 & 1 \\ 0 & 0 & -2 \end{bmatrix}$. Determine the state transition matrix.

Code No: RT22026 **R13** SET - 3

II B. Tech II Semester Regular Examinations, May/June - 2015
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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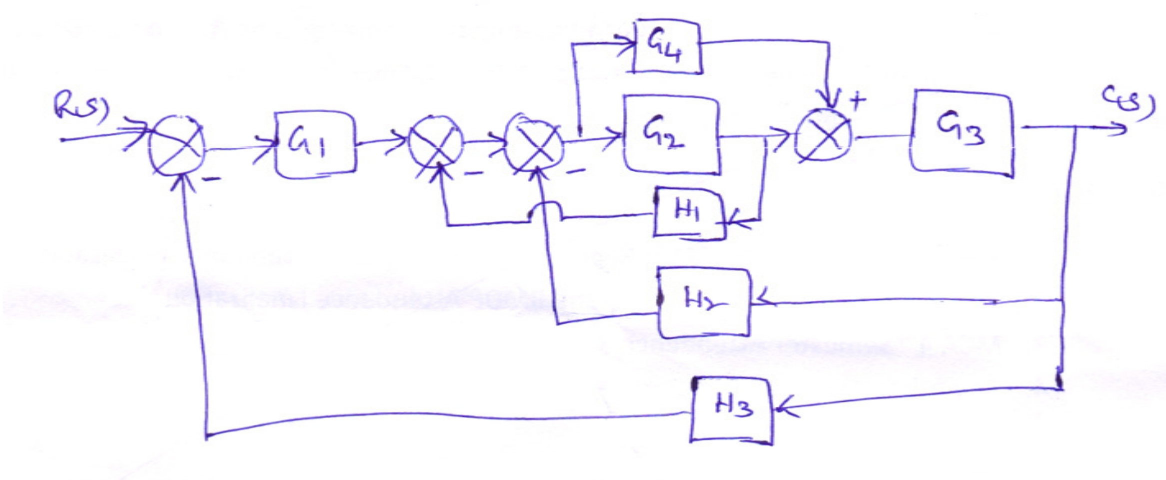
PART-A

1. a) Define the closed loop control system. Give its properties.
b) What is a synchro? Write its transfer function.
c) What are the standard test signals used in time domain analysis?
d) What are the disadvantages of Routh Criterion?
e) Define phase margin and gain margin.
f) What is the need of lag –lead compensator?
g) What is controllability? (4M+3M+3M+4M+4M+2M+2M)

PART-B

2. Simplify the block diagram shown in below figure and obtain the closed loop transfer function



3. a) Obtain the time response of a first order system for a unit step input and plot its response.
b) A unity feedback system is characterized by the open loop transfer function

$$G(s) = \frac{1}{s(1+0.3s)(1+0.4s)}.$$

Determine the steady state error for unity step, unity ramp and unity acceleration inputs. Also determine the damping factor and natural frequency of dominant roots.

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4. a) Explain the procedure to draw root locus of a given transfer function.

   b) A feedback system has the open loop transfer function of G(s) = $\frac{Ke^{-s}}{s(s^2+2s+3)}$. Find the limiting values of K for maintaining stability.

5. a) Explain the frequency domain specifications of a second order system.

   b) Given the open loop transfer function G(s)= $\frac{5}{(1+2s+s^2)(1+3s)}$. Sketch the Nyquist plot and investigate the open loop and closed loop systems stability.

6. For the given open loop transfer function, G(s) = $\frac{K}{s(s+4)(s+6)}$.

   Design suitable lead compensation so that phase margin is ≥ 30^o and velocity error constant, $K_v \geq 15$

7. The state equation of a system is given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -3 & 1 \\ -2 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t), \quad t>0$$

   a) Is the system controllable?
   b) Compute the state transition matrix
   c) Compute $x_1(t)$ under zero initial condition and a unit step input

Code No: RT22026 **R13** SET - 4

II B. Tech II Semester Regular Examinations, May/June - 2015
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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PART-A

1. a) What are the advantages and disadvantages of open loop control system
b) What is the difference between AC servo motor and DC servo motor?
c) Define the transient response, and draw the time domain response of first order system.
d) What is the necessary and sufficient condition for stability?
e) What are the frequency domain specifications?
f) Draw the electrical equivalent circuits of lead, lag and lag-lead compensators.
g) What is observability? (3M+3M+3M+3M+3M+4M+3M)

PART-B

2. a) Explain the construction and principle of operation synchro transmitter.
b) Derive the transfer function and develop the block diagram of Armature controlled DC servo motor

3. a) Derive the time domain specifications of second order system with unit step input
b) Given the open loop transfer function of a servo system with unity feed back is $G(s) = \frac{6}{s(1+0.2s)}$. Obtain the steady state error of the system when subjected to an input signal given by $r(t) = a_0 + a_1 t + \frac{a^2 t^2}{2}$
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4. a) Explain the Routh's criteria with an example. What are its limitations.

   b) Determine the stability of the closed loop system whose open loop transfer is $\dfrac{5(2s+1)}{s(s+1)(1+3s)(1+0.5s)}$, using Routh-Hurwitz criterion.

5. Given the open loop transfer function with unity feedback as G(s)= $\dfrac{Ke^{-10s}}{s(2+s)(1+5s)}$. Draw the bode plot and determine the gain K for the gain cross over frequency to be 4 rad/sec.

6. A unit feedback system has an open loop transfer function G(s) = $\dfrac{K}{s(s+2)(0.3s+1)}$. Design a phase lag compensator to meet the following specifications:

   Velocity error constant = 10

   Phase margin ≥ 40^o

7. Determine the state transition matrix for the system $\dot{X} = AX$, where $A = \begin{bmatrix} -2 & 0 & 1 \\ 0 & -1 & 1 \\ 2 & 0 & -1 \end{bmatrix}$

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

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]

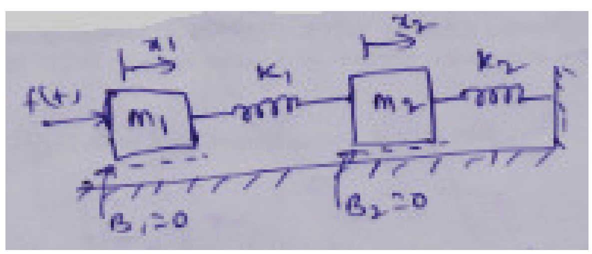
e) What is phase and gain crossover frequency? [3M]

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]

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 $G(s)=\frac{K}{S(S+1)(s+5)}$. [8M]

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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