SET - 1

Code No: 3220206

II B. Tech II Semester Regular Examinations, April/May 2009

CONTROL SYSTEMS

(Common to E.E.E, E.C.E, E.Con.E, E.C.C)

Time: 3 hours **Max Marks: 80**

Answer Any FIVE Questions

All Questions carry equal marks

1. a) Explain open loop control system with a practical example
   b) Discuss the advantages and disadvantages of closed loop control systems

2. a) Explain the working of AC servomotor and obtain its transfer function.
   b) What are the basic principles of signal flow graph?

3. A unity feedback control system has $G(s) = \dfrac{100}{s(s+5)}$. If it is subjected to unity step input.
   Determine
   (i) Damped frequency of oscillation. (ii) Maximum peak overshoot
   (iii) Time to reach for first overshoot (iv) Settling time

4. a) A feedback system has open loop transfer function of $G(s) = \dfrac{ke^{-s}}{s(s^2+5s+9)}$.
   Determine the maximum value of K for stability of closed loop system.
   b) Define the terms i) Absolute stability ii) Marginal stability and iii) conditional stability

5. a) Explain the concept of phase margin and gain margin.
   b) For the following transfer function, sketch the Bode magnitude plot.
   $$G(s) = \frac{40(1+s)}{(1+5s)(S^2+2s+4)}$$

6. Construct the Nyquist plot for a unity feedback control system whose open-loop transfer function is $G(s)H(s) = \dfrac{K}{s(s^2+2s+2)}$
   Find maximum value of K for which the system is stable.

7. a) Discuss about the design aspects of lead compensator using frequency response method
   b) Consider the forward path transfer function of a certain unity feedback system
   $$G(s) = \frac{200}{(s+2)(s+10)}$$
   The system is to have a phase margin of 50^0 at a frequency of 10 rad/sec. Design a PI controller.

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8. a)The state equations of a Linear system are as follows.

$$\dot{x} = \begin{bmatrix} -2 & 0 & 1 \\ 1 & -3 & 0 \\ 1 & 1 & -1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} u$$

$$y = [2 \;\; 1 \;\; -1]\, x$$

Determine the transfer function y(s)/u(s).

b) Explain various methods of evaluation of state transition matrix.

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CONTROL SYSTEMS

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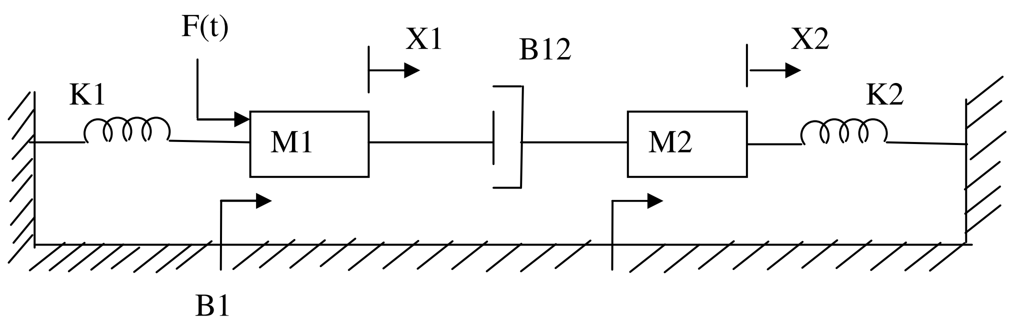
Time: 3 hours **Max Marks: 80**

Answer Any FIVE Questions

All Questions carry equal marks

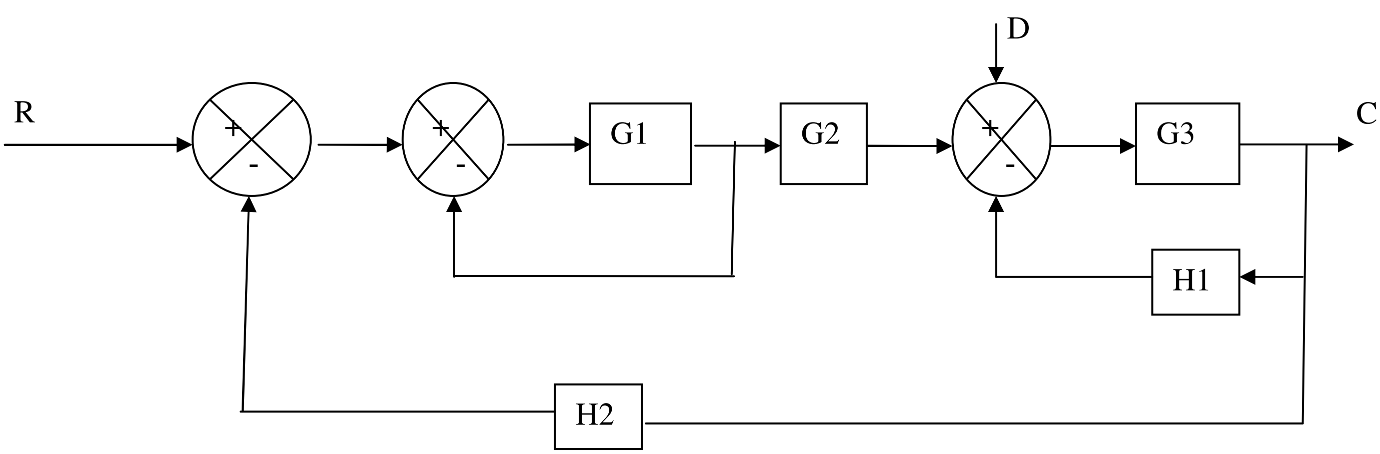
1. a) For the mechanical system given below, derive an expression for the transfer function.



b) Distinguish between open loop and closed loop system

2. a) Define path, loop, loop gain, non-touching loops forward path gain and explain Mason's gain formula

b) For the block diagram shown below find the ouput C due to R and disturbance D.



3. A second order servo system has unity feedback $G(s) = \frac{200}{s(s+5)}$. Sketch the transient response for unity step input, and calculate peak overshoot, settling time and peak time.

4. a) By means of Routh criterion, determine the stability of the system represented by the characteristic equation $s^4 + 2s^3 + 8s^2 + 4s + 3 = 0$

   b) What is root locus? List out the advantages of Root locus technique.

5. Sketch the bode plots and determine the gain cross-over and phase cross-over frequencies

   for the transfer function $G(s) = \dfrac{10}{s(1+0.5s)(1+0.1s)}$

6. The open loop transfer function of the system is

$$G(s)H(s) = \frac{(1+4s)}{s^2(1+s)(1+2s)}$$

   Determine the stability of closed loop system. If the closed loop system is not stable then find the number of closed-loop poles lying on the right half of s-plane.

7. a) Discuss about the design aspects of lag compensator using frequency response method

   b) Consider the forward path transfer function of a certain unity feedback system

$$G(s) = \frac{100}{(s+1)(s+2)(s+10)}$$

   The steady state error for unit ramp input is less than 0.08 rad and the phase margin should be greater than 50^0 at a frequency of 5 rad/sec. Design a PID controller.

8. A system is described by.

$$\bar{x} = \begin{bmatrix} -1 & -4 & -1 \\ -1 & -6 & -2 \\ -1 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = [1 \;\; 1 \;\; 1]\, x$$

   Determine the transfer function and construct the signal flow graph

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CONTROL SYSTEMS

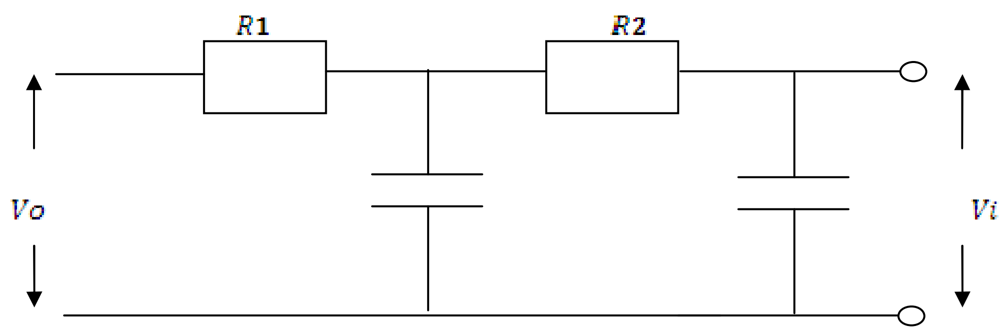
(Common to E.E.E, E.C.E, E.Con.E, E.C.C)

Time: 3 hours **Max Marks: 80**

Answer Any FIVE Questions

All Questions carry equal marks

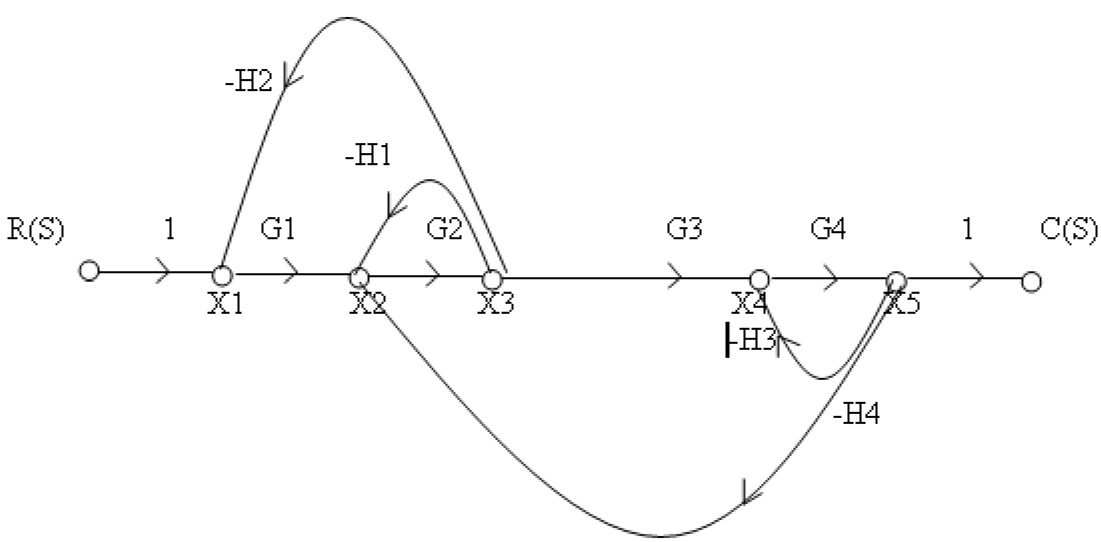
1. a) Find the transfer function of the electrical network shown below



b) Distinguish between open loop and closed loop system

2. a) Discuss the advantages and disadvantages of block diagram representation.

b) Find $\frac{C(s)}{R(s)}$ using Mason's formula for the signal flow graph shown below



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3. a) Explain error constants K_p, K_v, K_a for type 1 and type 2 systems.
   b) A unity feedback system is characterized by an open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K, determine settling time, peak overshoot and time to peak overshoot for a unit step input.

4. Sketch the root-locus plot and determine the approximate damping ratio for a value of K = 1.33 for a control system having a forward transfer function $G(s) = \frac{k(S+2)}{s^2 + 2s + 3}$

5. Draw the bode plot for a system having $G(s)H(s) = \frac{100}{s(s+1)(s+2)}$. Find
   i) gain margin
   ii) phase margin
   iii) gain cross over frequency
   iv) phase cross over frequency

6. The open loop transfer function of a certain negative feedback control system is given by

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

   i) Determine the stability of the system when H(s) = 1.
   ii) when H(s) = (1+2s).

7. a) Discuss about the design aspects of lead compensator using frequency response method

   b) Consider the forward path transfer function of a certain unity feedback system

$$G(s) = \frac{200}{(s+2)(s+10)}$$

   The system is to have a phase margin of 50^0 at a frequency of 10 rad/sec. Design a PI controller.

8. For the given transfer function $G(s)H(s) = \frac{b_0}{s^3 + a_2 s^2 + a_1 s + a_0}$

   Draw the signal flow graph and obtain the state model.

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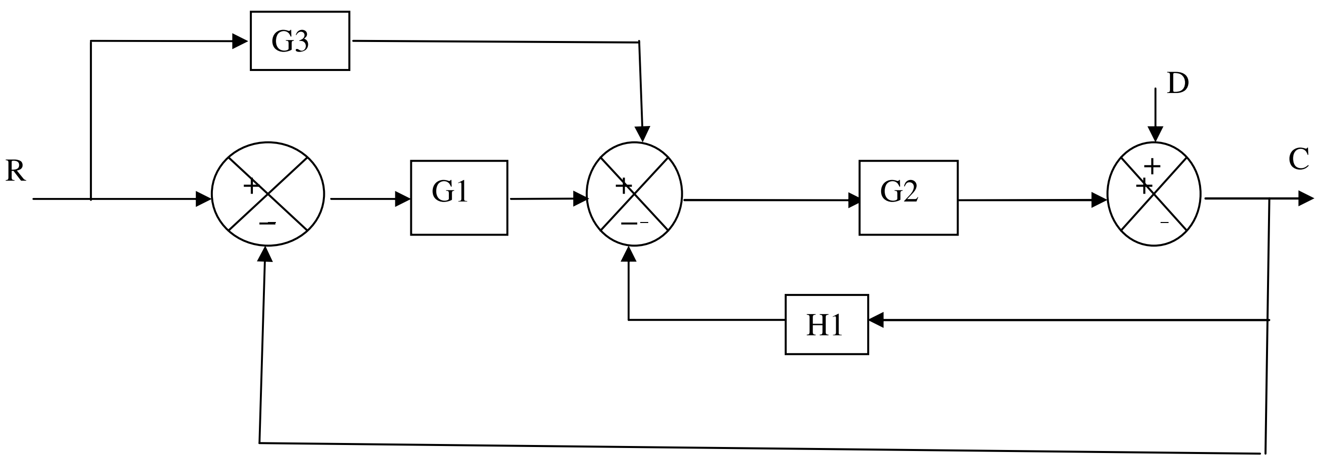
Time: 3 hours **Max Marks: 80**

Answer Any FIVE Questions

All Questions carry equal marks

1. a) Explain the effect of feedback on the stability of a closed loop system?
   b) Explain the effect of feedback on the sensitivity of a closed loop system?

2. a) For the block diagram shown below, find C.



   b) Explain about Mason's gain formula

3. a) A unity feedback system has $G(s)=\dfrac{1}{s(1+s)}$. The input to the system is described by r(t) = $4 + 6t + 2t^3$. Find the generalized error coefficients and hence the steady state error.

   b) Discuss the effect of pole location on transient response using appropriate transfer function.

4. A certain unity negative feedback control system has the following open loop T.F $GH(s)=\dfrac{k}{s(s+1)(s+3)}$. Draw the root locus for $0 \le K \le \infty$.

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5. a) Briefly explain the correlation between time and frequency response of a system

   b) Determine the value of K for a unity feedback control system having open loop T.F. $G(s) = \frac{K}{s(s+2)(s+4)}$ such that the gain margin is 20 dB +ve and phase margin is 60^0

6. The open loop transfer function of a certain unity negative feedback control system is given by $G(s)H(s) = \frac{10s(s+2)}{(s+1)(s+3)(s+5)}$

   Determine the stability of the closed loop system using Nyquist stability criterion.

7. a) Discuss about the design aspects of lag compensator using frequency response method

   b) Consider the forward path transfer function of a certain unity feedback system $G(s) = \frac{100}{(s+1)(s+2)(s+10)}$

   The steady state error for unit ramp input is less than 0.08 rad and the phase margin should be greater than 50^0 at a frequency of 5 rad/sec. Design a PID controller.

8. a) Obtain the state variable representation of a field controlled DC motor.

   b) Derive the expression for the transfer function from the state model.

$$\bar{x} = Ax + Bu$$
$$y = Cx + Du$$