Code No: V0223/R07 SET - 1

II B.Tech II Semester, Regular Examinations, Apr - 2011

CONTROL SYSTEMS
(Com. to EEE, ECE, ECC)

Time: 3 hours Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

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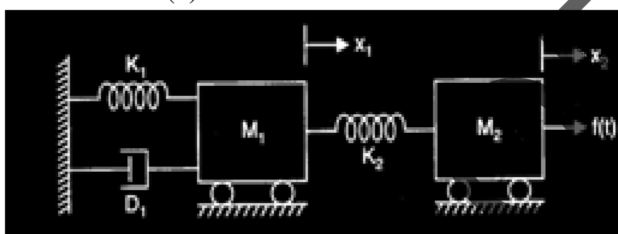
1. a) What is meant by feedback and list out its characteristics
   b) Find the transfer function $\frac{X_2(s)}{F(s)}$ of the system given in figure.



2. a) Explain the need of electrical analog systems
   b) Derive the transfer function and develop the block diagram of armature controlled DC servo motor

3. a) Determine the response of second order system with unit step input
   b) The open loop transfer function of unit feedback system is given by $G(s) = \frac{K}{s(1+Ts)}$.
   i) By what factor should the amplifier gain K be multiplied so that the damping ratio is increased from 0.2 to 0.7.
   ii) By what factor should K be multiplied so that the maximum overshoot of step response is reduced from 70% to 25%.

4. a) What are the limitations of Routh stability criterion? How to overcome them
   b) Sketch the root locus for the characteristic equation
   $s(s+1)(s+3)+k(s+4)=0$

5. Sketch the Bode plot and determine the following:
   i) Gain crossover frequency
   ii) Phase crossover frequency
   iii) Gain margin
   iv) Phase margin

   for the transfer function given as $G(s) = \frac{10(2+s)e^{-0.1s}}{s(1+0.4s)}$

6. A unity feedback control system has an open loop transfer function given by $G(s)\ H(s) = \frac{50}{s(s+4)(s+2)}$. Draw Nyquist diagram and Comment on stability.

7. a) What is the need of lead compensator? Derive its transfer function and also draw the bode plot
   b) Explain the design procedure of PID controllers

8. a) What are the merits and demerits of state variable techniques
   b) Determine the state controllability and observability of the following system:
   $A = \begin{bmatrix} -1 & 0 \\ 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 2 \end{bmatrix}$

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SET - 2

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CONTROL SYSTEMS

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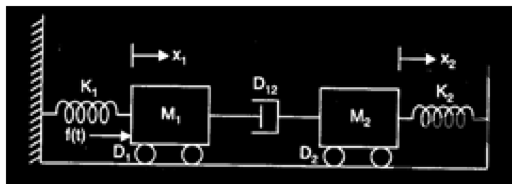
1. a) What is meant by closed loop system? Illustrate with practical examples
   b) A mechanical system is shown in figure. Derive its transfer function.



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

3. a) Define the steady state error and obtain error constants of different types of inputs.
   b) A unit feedback control system has a loop transfer function, $G(s) = \frac{8}{s(s+3)}$. Find the rise time, percentage overshoot, peak time and settling time for a step input of 12 units.

4. a) Explain the construction rules for root locus technique
   b) A feedback system has the open loop transfer function of $G(s) = \frac{ke^{-s}}{s(s^2+2s+5)}$. Find the limiting values of 'k' for maintaining stability.

5. a) Derive frequency domain specifications
   b) Explain the phase margin and gain margin with respect to bode plat

6. $G(s) = \frac{1}{s(s+1)(s+2)}$. Draw the Nyquist plot and test the stability. also find ω_{pc}, ω_{gc}, PM and GM.

7. Consider a unity feedback system with open loop transfer function $G(s) = \frac{K}{s(1+s)(2+s)}$.
   Design a suitable compensator so that the compensated system has
   i) $K_v = 10\sec^{-1}$
   ii) Phase margin = 50^0
   iii) Gain margin = 10 dB

8. a) Define the following
   i) State
   ii) State variables
   iii) State vector
   iv) State equations

   b) The state variable formulation of a system is given by
   $[\dot{x}] = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix}[x] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \text{ and } y = \begin{bmatrix} 1 & 0 \end{bmatrix}[x]$. Determine the following
   i) Transfer function of the system
   ii) State transaction matrix and
   iii) State equation for a unit step input under zero initial condition.

Code No: V0223/R07 SET - 3

II B.Tech II Semester, Regular Examinations, Apr - 2011

CONTROL SYSTEMS

(Com. to EEE, ECE, ECC)

Time: 3 hours Max Marks: 80

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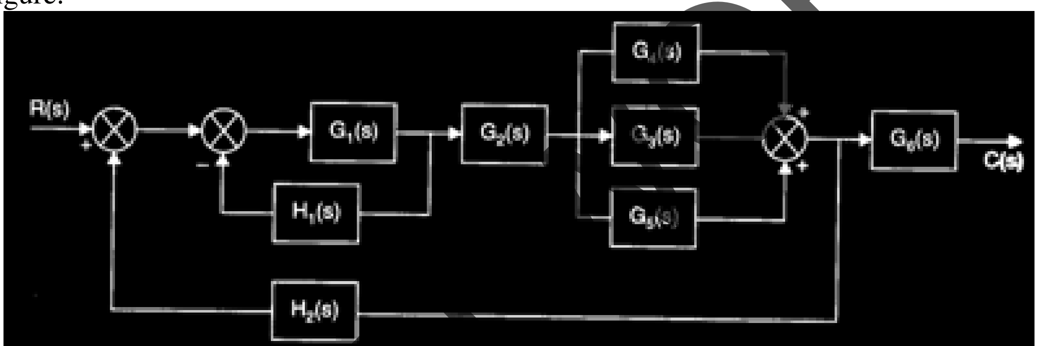
1. a) What are the differences between open loop control and closed loop control systems
   b) Explain the effect of feedback on sensitivity
   c) What do you represent a control system by the block diagram. Illustrate with an example

2. a) Explain AC servomotor and draw its torque and speed characteristics
   b) Using method of reduction, determine the ratio $\frac{C(s)}{R(s)}$ in the block diagram as shown in figure.



3. a) Define time domain specifications
   b) The open loop transfer function of a control system with unity feedback system 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 $\left(1+4t+\frac{3t^2}{2}\right)$.

4. Sketch the root locus plot of unity feedback system with an open loop transfer function $G(s) = \frac{k}{s(s+2)\,(s+4)}$. 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 0.5. Corresponding to this value of k, determine the closed loop transfer function in the factored form.

5. Sketch the Bode plot and determine the following:
   i) Gain crossover frequency
   ii) Phase crossover frequency
   iii) Gain margin
   iv) Phase margin
   for the transfer function given $G(s) = \frac{50(1+0.2s)}{s(s^2+16s+100)}$.

6. a) Explain the procedure to construct the Nyquist Plot

   b) Draw the polar plot for the transfer function $G(s) = \dfrac{1}{s^2(1+s)(1+2s)}$. Determine the frequency at which the plot crossed the real axis and the corresponding $|G(j\omega)|$.

7. a) Describe the different types of compensation methods

   b) Explain the design procedure of lag-lead compensation in frequency domain

8. a) Derive the properties of state transition matrix

   b) Determine the state model of the system for the following transfer function

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

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SET - 4

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CONTROL SYSTEMS

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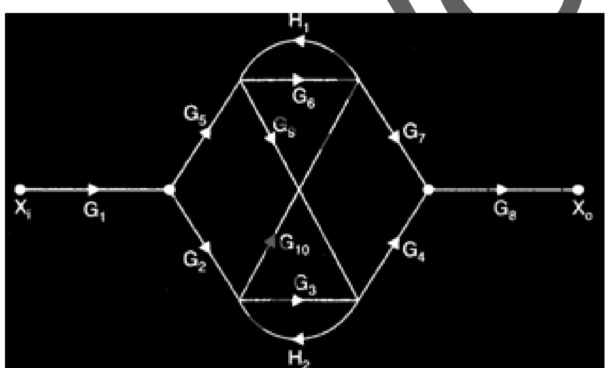
1. a) What is meant by open loop and closed loop control systems and list out their differences
   b) Explain the effect of feedback on system stability

2. a) Explain the construction and operation principle of synchro transmitter
   b) Using Mason's gain formula, find the gain $\frac{X_0}{X_i}$ for the signal flow graph as shown in figure.



3. a) Derive the time domain specifications of second order system with unit step input

   b) Find the step, ramp and parabolic error coefficients and their corresponding steady state errors for unity feedback control system having the transfer function.

$$G(s) = \frac{14(s+3)}{s(s+5)(s^2+2s+5)}$$

4. A unity feedback system has an open loop function $G(s) = \frac{k}{s(s^2+4s+13)}$. 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 $j\omega$ axis and
   v) Maximum value of k for stability.

5. Sketch the Bode plot and determine the following:
   i) Gain crossover frequency
   ii) Phase crossover frequency
   iii) Gain margin
   iv) Phase margin

   for the transfer function given $G(s) = \dfrac{K}{s(s+1)(s+3)}$ and determine the K for stability.

6. a) Discuss the calculation of gain cross over frequency and phase cross over frequency with respect to the polar plots
   b) State and explain Nyquist stability criterion

7. 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 $\geq 40^0$

8. a) State and explain controllability and observability
   b) The state equations of LTIV is represented by $\dot{x} = Ax + Bu$. Find the state transition matrix.

$$A = \begin{bmatrix} -2 & 0 & 0 \\ 0 & -1 & 1 \\ 0 & 0 & -1 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$