Academic Year :2018-2019
Department :ECE
Year/Semester :II YEAR– I SEMESTER
Subject : **Control Systems**

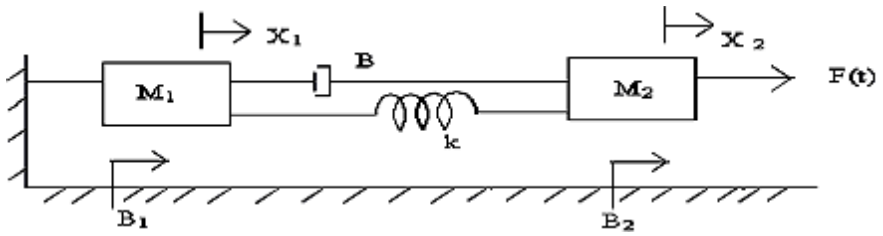
UNIT-1

1. a) Define control systems. Explain the difference between closed loop and open looped system with a suitable example. **[4M]**

b) What do you mean by the sensitivity of the control system and discuss the effect of feedback on sensitivity. **[6M]**

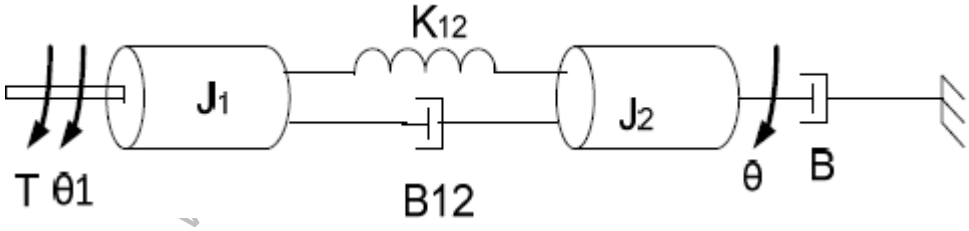
2. a) What are the characteristics of negative feedback **[4M]**

b) Draw the free body diagram and write the differential equations describe the dynamics of the system shown in below figure and obtain the transfer function $\frac{X2}{F(s)}$. **[6M]**



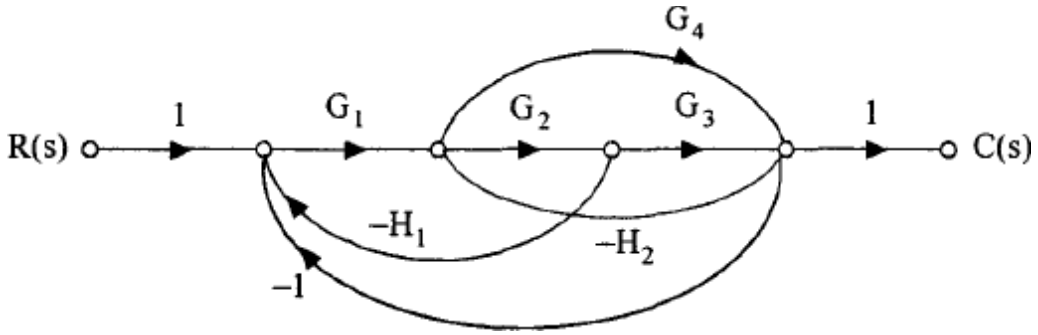
3. a) Write the advantages and disadvantages of open loop and closed loop control systems **[4M]**

b) Find the transfer function $\frac{\theta(S)}{T(S)}$ **[6M]**



4. a) State and explain the Mason's gain formula **[4M]**

b) Find the transfer function $\frac{C(S)}{R(S)}$ **[6M]**



UNIT-2

1. a) Mention two advantages of generalized error constants over static error constants **[4M]** . Evaluate the
   b) The open loop transfer function of a servo motor with unity feedback is $G(s) = \frac{10}{s(0.1s+1)}$

   static error constants of the system. Obtain the steady state error of a system when subjected to an input given by the polynomial $r(t) = a_0 + a_1 t + \frac{a_2}{2} t^2$

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

   b) A unity feedback control system has its open loop transfer function given by $G(s) = \frac{(4s+1)}{(4s^2)}$.

   Determine an expression for the time response when the system is subjected to 1) unit impulse input function 2) unit step input function. **[6M]**
3. a) Define the error constants K_P, K_V , K_a **[4M]**
   b) Derive the response of a standard under damped 2nd order system for unit step input.

   [6M]

4. a) Draw the unit step response of a 1st order system and explain. **[4M]**

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

   $G(s) = \frac{500}{(1+10s)}$ **[6M]**
5. a) Write short notes on steady state error **[4M]**
   b) Explain the effect of proportional control action on the performance of second order system

   [6M]

UNIT-3

1. a) What is routh stability criterion **[4M]**
   b) Determine the value of ' K' such that the roots of the characteristic equation given below lie to the left of the line s= -1, $s^3 + 10s^2 + 18s + K = 0$ **[6M]**
2. a) What are asymptotes? How will you find the angle of asymptotes. **[4M]**
   b) Draw the root locus plot for a system having open loop transfer function is $G(s) = \frac{K}{s(s+5)}$

   [6M]
3. a) Explain about the effects of adding zeros to G(s) H(s) on the root loci **[4M]**
   b) Explain the procedure to draw the root locus of a given transfer function **[6M]**
4. a) For a unity feedback system with open loop transfer function $G(s)H(s) = \frac{K}{s(s+6)}$

Find the range of

K for which the system will be stable using RH criterion. **[4M]**

b) Explain the routh criterion with an example and what are its limitations **[6M]**

5. a) Explain the advantages of root locus technique **[4M]**

b) Using routh Hurwitz criterion determine the stability of closed loop system that has the following characteristic equation and also determine the number of roots that are in the right half of s-plane and on the imaginary axis $s^4 + s^3 + 3s^2 + 2s + 5 = 0$ **[6M]**

UNIT-4

1. a) What are the advantages of bode plot. **[4M]**

b) Find the gain margin and phase margin of the system if the open loop transfer function is $G(s) = \frac{0.5}{s^2+3s+2}$ **[6M]**

2. a) Define resonant peak and bandwidth **[4M]**

b) Define various frequency domain specifications **[6M]**

3. a) What is phase and gain crossover frequency **[4M]**

b) Construct bode plot for the system whose open loop transfer function is given below, $G(s)H(s) = \frac{4}{s(1+0.5s)(1+0.08s)}$ **[6M]**

4. a) Define resonant peak and bandwidth **[4M]**

b)Find the gain margin and phase margin of the system if the open loop transfer function is $G(s) = \frac{10}{s(s+1)}$ **[6M]**

5. a) Define resonant frequency and cut off rate **[4M]**

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

UNIT-6

1. a) Define controllability and Observability **[4M]**

b) Define state transition matrix and explain its properties with examples. **[6M]**

2. a) For the system given below obtain total response **[4M]**

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) \text{ where } x_1(0) = 1, x_2(0) = 0, u(t) = 1$$

b) Why compensation is necessary in feedback control system. **[6M]**

3. a) The transfer function of control system is given by $\frac{Y(s)}{U(s)} = \frac{s+2}{(s^3+9s^2+26s+24)}$ check controllability and Observability. **[4M]**

b) Explain about lead compensator **[6M]**

4. a) A system is characterized by the following state space equation.

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

$$Y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$ Find the transfer function of the system. **[4M]**

b) Compute state transition matrix of above system. **[6M]**

5. a) What is meant by Observability **[4M]**

b) Determine the state and output equations in vector matrix form for the system whose transfer function is given by $G(s) = \frac{(s+3)}{s(s^2+3s+2)}$ **[6M]**