Name of the subject : Control systems **Branch: ECE** **Year / sem : III / I**

UNIT – 1

1.a) Write the differential equations governing the mechanical system shown below fig. 1.1 and determine the transfer function Y1(s)/F(s).

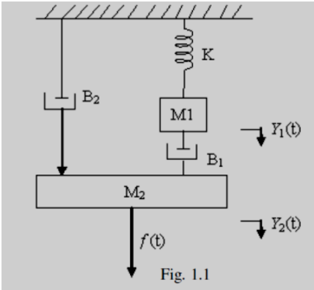


Fig. 1.1

b) Discuss the advantages and disadvantages of closed loop control systems

2. For the mechanical system shown below fig.1.3 find the F – I analogous circuit?

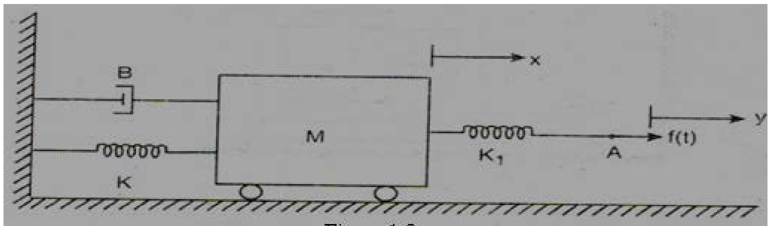


Figure 1.3

3. Distinguish between open loop and closed loop systems. Give practical examples for both.
4. Determine the transfer function Eo(s) to Ei(s) for the network shown in figure (1).

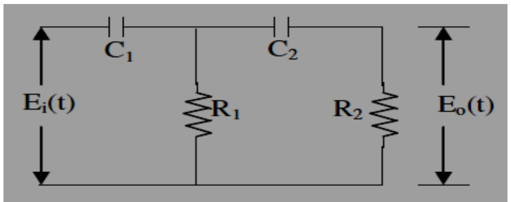


Figure (1)

5. What is the classification of control systems and discuss the importance of mathematical

Modeling of a control system..
6. Define the transfer function and discuss the limitations in transfer function representation

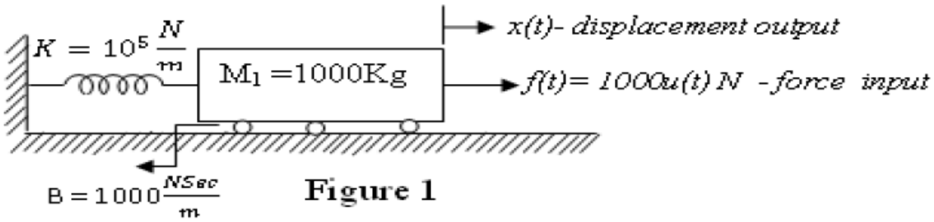


Figure 1

7. Write the governing differential equations of the mechanical system shown in Fig. P1

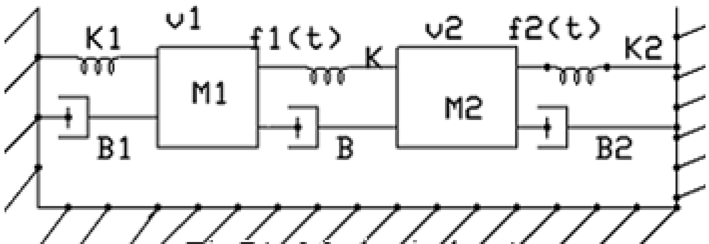


Fig.P1 Mechanical system

8. a) what is the impulse response? Also explain its significance.

b. Explain merits and demerits of closed loop systems

9. Write the differential equations governing the behavior of the mechanical system shown in figure 4 draw the mechanical network and obtain the transfer function

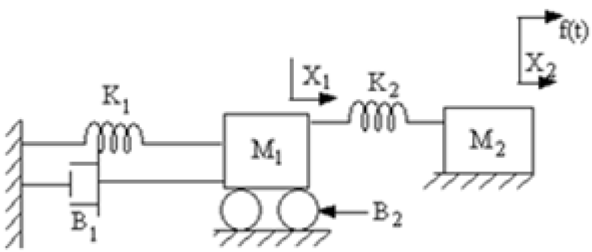


Figure 4

10. Find the transfer function of the following system show in figure.5

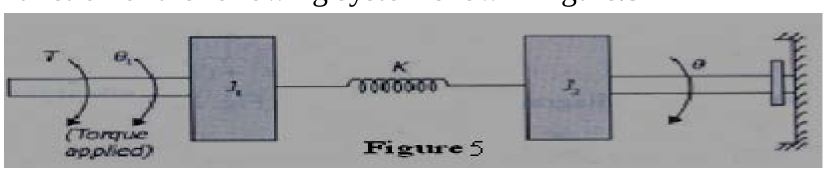


Figure 5

11. For the mechanical system shown in Figure 7, determine the transfer function Y1(s)/F(s).

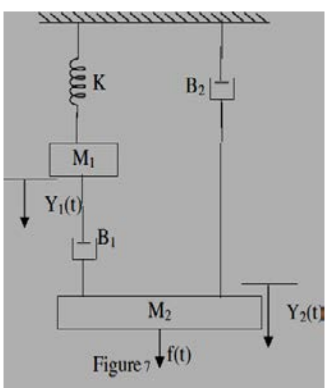


Figure 7

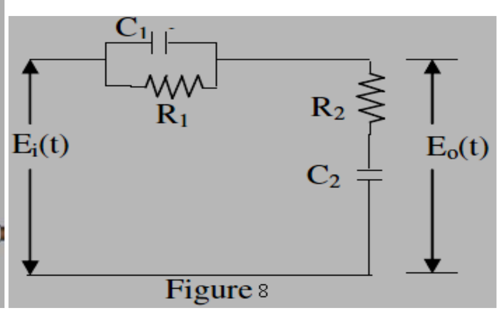


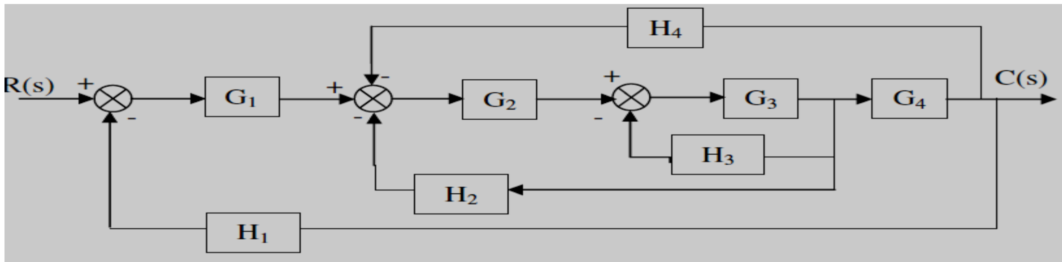
Figure 8

12.a) Show that feedback results in reduction of overall gain and reduction of system sensitivity to parameter changes.

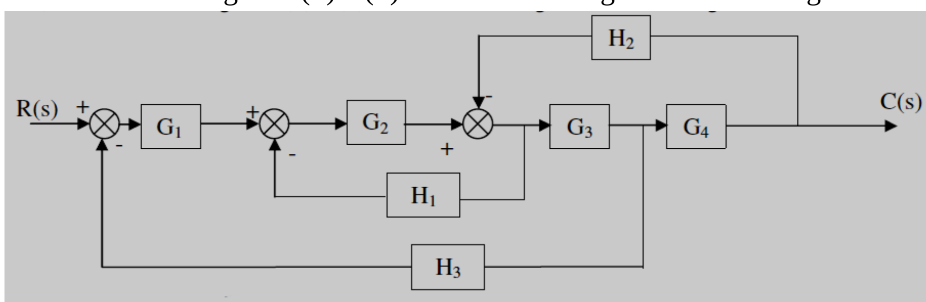
b) Find the transfer function Eo/Ei of the circuit given in Figure 8

UNIT-2

1. Figure shows a block diagram representation of a system. Draw the signal flow graph and find the transfer function C(s)/R(s).



2. Find the overall gain C(S)/R(S) for the block diagram shown in Figure



3. For the system represented in the given Figure, obtain transfer function i)C/R_1 ii)C/R_2

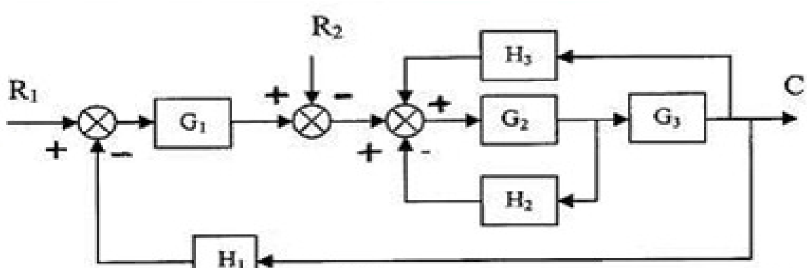
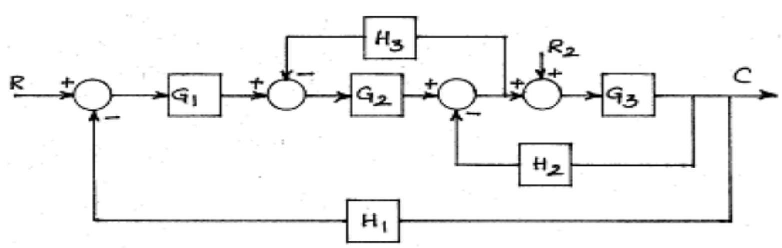
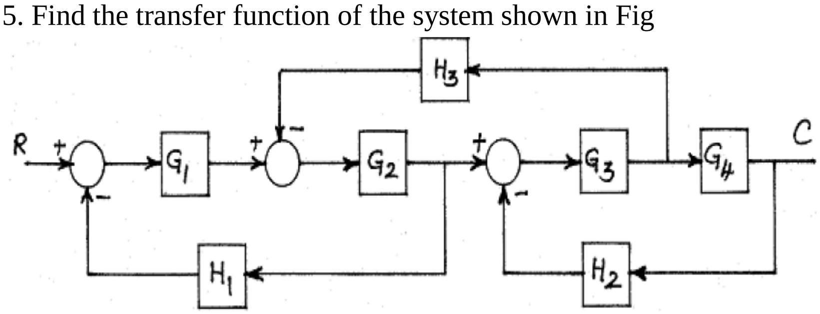


Figure 4

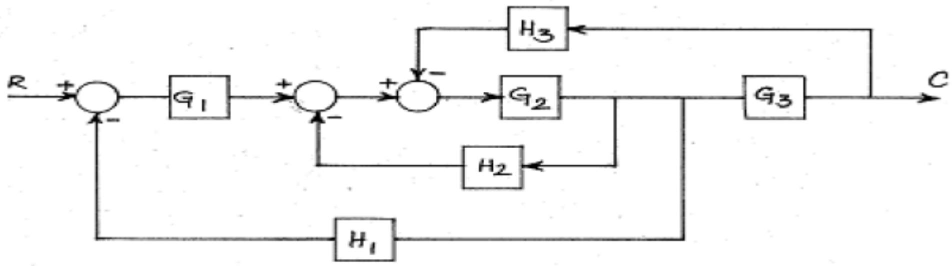
4. Using block diagram reduction techniques, find the closed loop transfer function of the system whose block diagram is given in Fig



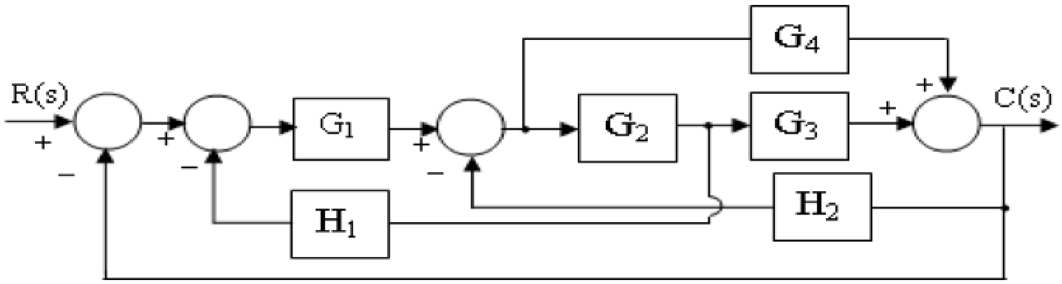
5. Find the transfer function of the system shown in Fig



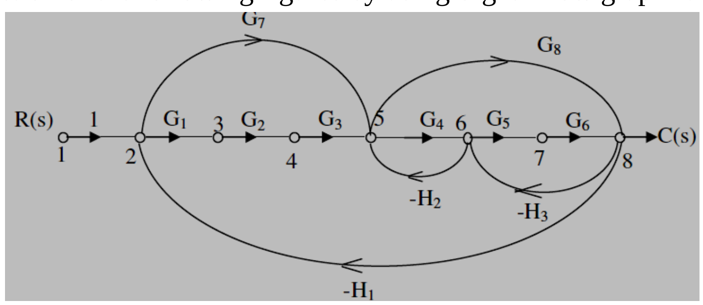
6. Find the closed loop transfer function of the system whose block diagram is given in Fig



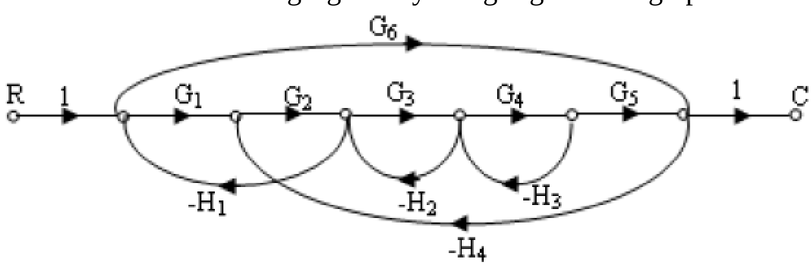
7. Obtain the overall transfer function C(s)/R(s) of the system shown in figure 2 using block Diagram reduction technique.



8. Find out transfer function of the following figures by using Signal flow graph rules



9. Find out transfer function of the following figures by using Signal flow graph rules



10.Determine the tranfer function of the DC Servo motor by using Armature control and field control methods?

11.Explain about the synchro transmitter and receiver?

12.Explain the AC Servo motor and its transfer function?

UNIT-3

1.Derive the time domain specifications for a standard second order system

2. A unity feedback system is characterized by the open loop transfer function

$$G(s) = \frac{K}{s(s+10)} .$$

Determine the gain K so that the system will have a damping ratioof 0.5. For this value of K, determine time domain specification

3. Determine the response of second order system with unit step input

4. 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%.

5. A unity feedback control system has

$$G(s) = \frac{100}{s(s+5)}$$

. 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

6. Explain the significance of generalized error series

7. For a system

$$G(s)H(s) = \frac{K}{s^2(s+2)(s+3)},.$$

. Find the value of K to limit the steadystate error to 10 when the input to the system is r(t)=1+10t+40/2 t2.

8. Explain error constants Kp, Kv, Ka for type-1 system

9. A unity feed back system has an open loop transfer function

$$G(s) = \frac{25}{s(s+8)}.$$

Determine its damping ratio, peak overshoot and time required to reach the peak output. Now a derivative component having T.F. of s/10 is introduced in the system. Discuss its effect on the values obtained above.

10. Explain about various test signals used in control system

11. What are integral controllers and why are they used in combination with proportional controllers?

12. What are derivative controllers and why are they used in combination with proportional controllers?

UNIT-4

1.Explain the procedure to construct the root locus

2.What are the limitations of Routh's stability? Define the terms i) Absolute stability ii) Marginal stability and iii) conditional stability

3.Sketch the root locus for the characteristic equation

$$s(s+1)(s+3)+k(s+4)=0$$

4. By means of Routh criterion, determine the stability of the system represented by the characteristic equation s4 + 2s3 + 8s2 + 4s + 3 = 0

5. For the system having characteristic equation 2S4 + 4S2 + 1 = 0, find the Following

i. the no. of roots in the left half of s-plane

ii. the no. of roots in the right half of s-plane

iii. the no. of roots on the imaginary axis.

Use the RH stability criterion

6. Sketch the root locus of the unity feedback system whose open loop transfer function is

$$G(s)=\frac{K}{s\,(s+2)\left(s^{2}+4s+13\right)}$$

7. 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

$$G(s)=\frac{k(S+2)}{s^{2}+2s+3}$$

8. The open loop t.f. of a unity feed-back system is given by

G(s) = K/s(1+0.25s)(1+0.4s) .

Find the restriction on K so that the closed loop system is absolutely stable?

9. The open loop T.F. of a control system is given by

G(s)H(s) = K/s(s+6)(s2+4s+13)

Sketch the root locus plot and determine

(a) the break-away points

(b) The angle of departure from complex poles

(c) the stability condition.

10. Using Routh – Hurwitz criterion for the unity feedback system with open loop transfer function

$$G(s)=\frac{K}{s\,(s+1)(s+2)(s+3)}$$

i) Find the range of K for stability ii) Find the value of k for marginally stable

11.

unit-5

1. Determine the closed loop bandwidth, closed – loop peak magnitude, phase margin and gain margin for the following system

$$G(s) = \frac{4}{s(s+1)}.$$

2. Sketch the bode plot for the following open loop transfer function

$$G(s) = \frac{10(s+3)}{s\,(s+2)(s^2+4s+100)}$$

3. Draw the bode plot for the unity feedback system with open loop transfer function

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

Hence find gain margin and phase margin

4. The open loop transfer function of a unity feedback system is given by

$$G(s) = \frac{K(s+20)}{(s+1)(s+2)(s+10)}$$

Construct bode plot for K=10. Determine phase margin and gain margin. Also determine whether the closed loop system is stable

5. Draw the log-magnitude plot and phase plot for a system with open-loop transfer function

$$G(s)H(s) = \frac{12650}{(S+10)(S+20)^2}$$

And obtain the gain margin and phase margin of the closed-loop system

6. Sketch the bode plot for a system with unity feedback having the transfer function, and

$$G(s) = \frac{1000(s+1)}{s(s+2)(s+5)(s+10)}$$

assess its closed-loop stability.

7. Obtain the expression for resonant frequency and resonant peak for a standard second order system.

8. What is gain margin and phase margin? How stability analysis can be done using Bode plots?

9. A unity feedback control system has an open loop transfer function given by

$$G(s)H(s) = \frac{100}{(s+5)(s+2)}$$

Draw the Nyquist diagram and determine its stability.

10. For the following system sketch the polar plot

$$G(s)H(s) = \frac{500}{s(s+6)(s+9)}$$

11. Draw the bode plot for the unity feedback system with open loop transfer function

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

Hence find gain margin and phase margin

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

$$G(s)H(s) = \frac{K}{(S+1)(S+2)(S+3)}$$

Using Nyquist stability criterion, find the range of values of K for which the system remains stable

Unit – 6

1.Explain the lead-lag compensator and derive its transfer function

2. Describe the procedure for the design of lag compensator in frequency design.

3. Explain the lag compensator and derive its transfer function

4. Describe the procedure for the design of lead compensator in frequency domain

5. The open loop transfer function of a unity feedback system is

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

Design a lead compensator to have a velocity-error constant of 20 s-1 and a phase margin of atleast 500.

6. The open loop transfer function of a unity feedback system is

$$G(S) = \frac{4}{S(S+2)}.$$

Design a lead compensator for the system so that the static velocity error constant kv = 20 sec-1, the phasemargin is at least 500, and the gain margin is at least 10 dB.

7. Derive the state models for the system described by the differential equation in phase variable form

$$\dddot{y} + 4\ddot{y} + 5\dot{y} + 2y = 2\ddot{u} + 5\dot{u} + 5u$$

8. The state equation of a linear system is given by

$$[\dot{x}] = \begin{bmatrix} -1 & -2 \\ 0 & -4 \end{bmatrix}[x] + \begin{bmatrix} 1 \\ 0 \end{bmatrix}[u]$$

Obtain the state transition matrix

9. Given the state equation X =AX where

$$A = \begin{bmatrix} -3 & 1 & 0 \\ 0 & -3 & 1 \\ 0 & 0 & -2 \end{bmatrix}.$$

Determine the state transition matrix.

10. Discuss about the properties of state transition matrix.

. Determine the state controllability and observability of the following system

$$A = \begin{bmatrix} -1 & 0 \\ 0 & -3 \end{bmatrix}, B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 2 \end{bmatrix}$$

11. The state equations of a Linear system are as follows.

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

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

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

12. Find the canonical format representation and state transition matrix.

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

$$y = \begin{bmatrix} -3 & 5 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$