Code No: R2022044 **R20** **SET - 1**

II B. Tech II Semester Regular/Supplementary Examinations, July - 2023

LINEAR CONTROL SYSTEMS

(Common to ECE & EIE)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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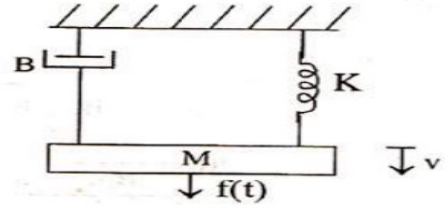
UNIT-I

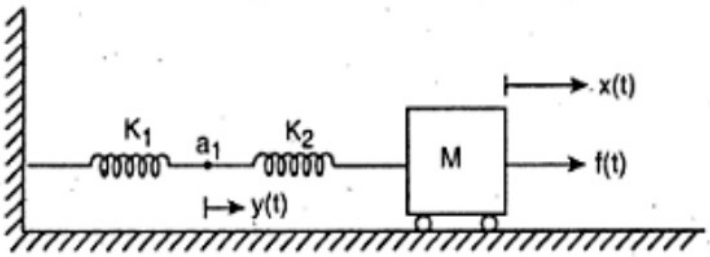
1. a) Determine the transfer function V(s)/F(s), for the system show in below figure: [7M]



b) Compare open loop and closed loop control systems based on different aspects. [7M]

(OR)

2. a) Determine the differential equation for the given mechanical system as shown in figure and derive its transfer function and also draw the electrical equivalent analogous system. [7M]



b) Explain the necessity and effect of feedback in control systems. [7M]

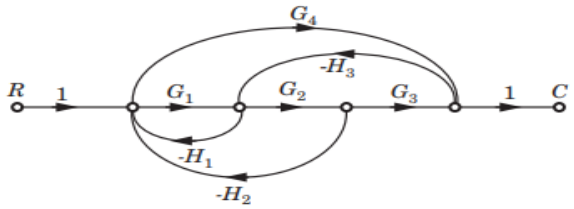
UNIT-II

3. a) Derive the transfer function of Synchronous transmitter. [7M]

b) A unity feedback servo-driven instrument has an open loop transfer function: G(s)=10/s(s+2). Find the time domain specification for a unit step input. [7M]

(OR)

4. a) Compute the transfer function for control function shown below figure using Mason's gain formula: [9M]



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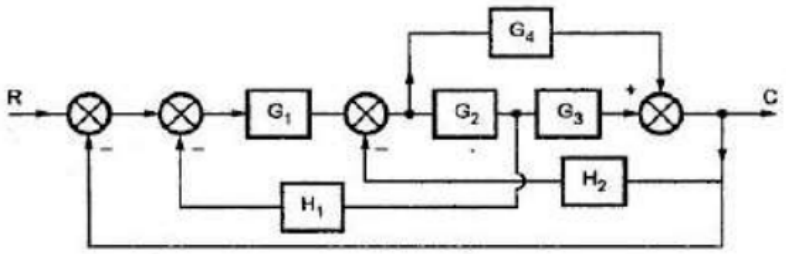
b) Using Block diagram reduction technique find the Transfer Function of the system. [5M]



UNIT-III

5. a) Explain how Routh Hurwitz criterion can be used to determine the absolute stability of a system. [7M]

b) With the help of Routh's stability criterion find the stability of the following system represented by the characteristic equation: $s^4 + 8s^3 + 18s^2 + 16s + 5 = 0$. [7M]

(OR)

6. a) Enlist qualitative stability & conditional stability. [7M]

b) Calculate the angle of asymptotes and the centroid for the system having: [7M]

$$G(s)H(s) = \frac{K(S+3)}{S(S+2)(S+4)(S+5)}.$$

UNIT-IV

7. a) Derive the expressions for resonant peak and resonant frequency and hence establish the correlation between time response and frequency response. [7M]

b) Sketch the Bode plot for the following Transfer Function : [7M]

G(s) H(s) = $\frac{20(0.1S+1)}{S^2(0.2S+1)(0.02S+1)}$ From the bode plot determine

(i) Gain Margin (ii) Phase Margin (iii) Comment on the stability

(OR)

8. a) Sketch the polar plots of typical Type 0, 1 and 2 systems and explain the salient features of these plots. [7M]

b) Explain about gain crossover frequency and phase cross over frequency. [7M]

UNIT-V

9. a) Explain the design of Lead-Lag controller. [9M]

b) Write the effect and limitation of phase-lag controller. [5M]

(OR)

10. a) Transfer function of a system is given by: [7M]

$\frac{Y(s)}{U(s)} = \frac{2}{s^3+6s^2+11s+6}$. find controllability and observability.

b) Check whether given system is Observable or controllable, [7M]

$$A = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix}, \quad c = [1 \quad 0 \quad 0]$$

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LINEAR CONTROL SYSTEMS

(Common to ECE & EIE)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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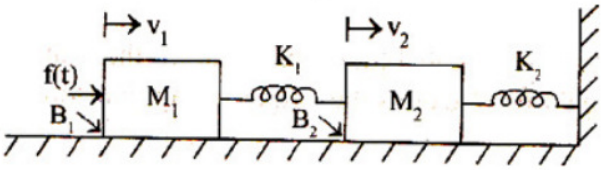
UNIT-I

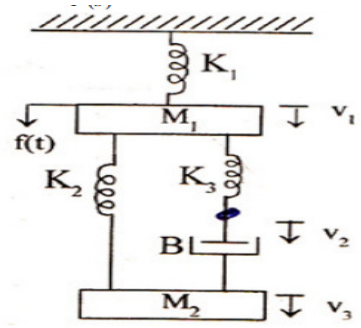
1. a) $\frac{V_2(S)}{F(S)}$,for the system show in below figure: [7M]



b) Describe the effect of feedback on system stability and sensitively. [7M]

(OR)

2. a) Determine the transfer function $v_3(s)/F(s)$, for the system shown in below figure: [7M]



b) How the control systems are classified? What are its various types. [7M]

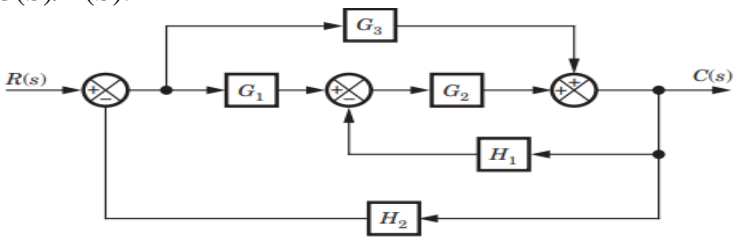
UNIT-II

3. a) Derive the transfer function and develop the block diagram of armature controlled DC servo motor. [5M]

b) Derive the expression for response of Undamped second ordered system for unit step input. [10M]

(OR)

4. a) For the system represented in the given figure, determine transfer function C(S)/R(S). [7M]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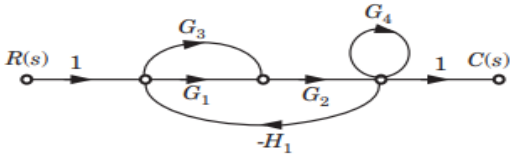
b) Find the overall transfer function of the system whose signal flow graph is shown below. [7M]



UNIT-III

5. a) A system has : [7M]

$$G(s)\,H(s)=\frac{K}{s(s+2)(s+4)(s+8)}$$

Where K is positive. Determine the range of K for stability.

b) With the help of Routh's stability criterion find the stability of the following system represented by the characteristic equation: [7M]

$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$.

(OR)

6. a) Sketch the root locus for the characteristic equation is [7M]

S(S+1) (S+2)+K(S+1)-5=0.

b) Sketch the root locus of the system whose open loop transfer function is G(s) H(s) = $\boldsymbol{K\,(S+9)\,/\,S(S^2+4S+11)}$. [7M]

UNIT-IV

7. a) Draw the magnitude bode plot for the system having the following transfer function: [7M]

$$\mathbf{G(s)\,H(s)=\frac{2000\,(S+1)}{S(S+10)\,(S+40)}}$$

b) Given $\xi = 0.7$ and $\omega_n = 10$ rad/sec. Calculate resonant peak, resonant frequency and bandwidth. [7M]

(OR)

8. a) Sketch the polar plot for the open loop transfer function of a unity feedback system is given by : [7M]

$$\mathbf{G(s)=\frac{1}{S(1+S)\,(1+2S)}.}$$

Determine Gain Margin & Phase Margin.

b) Draw the Nyquist plot for the system whose open loop transfer function is, G(s)H(s) = $\boldsymbol{K\,/\,S(S+2)\,(S+10)}$. Determine the range of K for which closed loop system is stable. [7M]

UNIT-V

9. a) Determine the state controllability and observability of the system described by: [7M]

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

b) Enumerate the design steps involved in phase lag-lead compensation. [7M]

(OR)

10. a) Define State, State variable, State model & State diagram. [7M]

b) Obtain the state model of the system whose transfer function is given by: [7M]

$$T(S)=\frac{S^2+3S+3}{S^3 2S^2+3S+1}$$

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II B. Tech II Semester Regular/Supplementary Examinations, July - 2023

LINEAR CONTROL SYSTEMS

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Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
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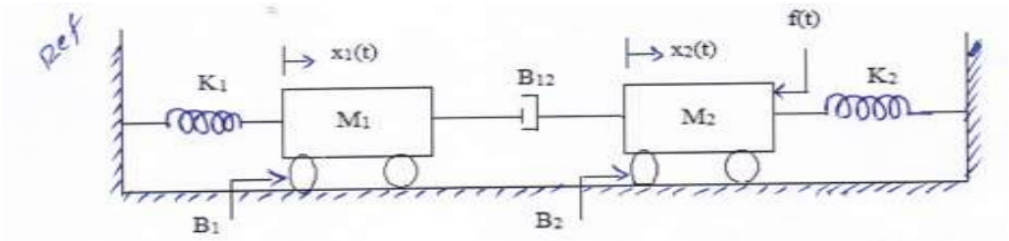
UNIT-I

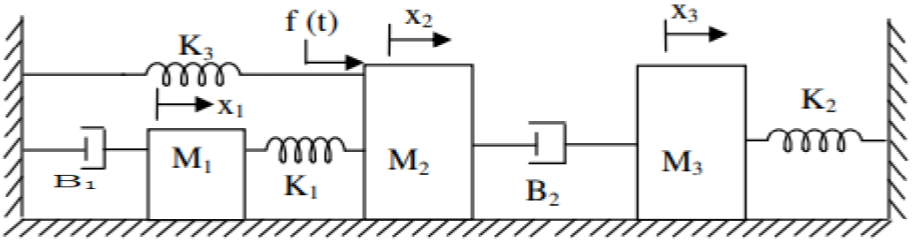
1. a) For the mechanical system shown in Fig, determine the transfer functions $\mathbf{X_1(s)/F(s)}$ & $\mathbf{X_2(s)/F(s)}$ [7M]



b) Define control system. Write the different types with numerical control systems with example. [7M]

(OR)

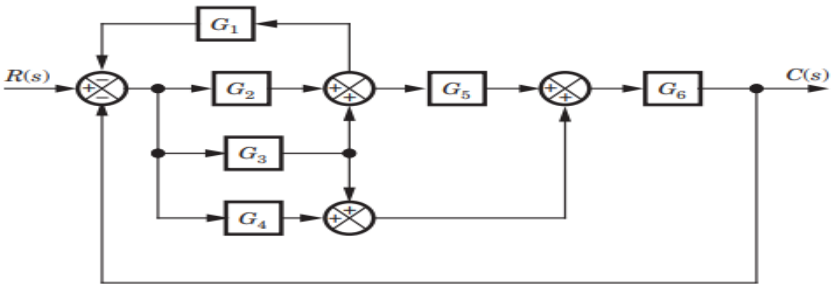
2. a) Obtain the mathematical model of the mechanical system shown in below Figure: [7M]



b) Derive the transfer function of Translational mechanical system. [7M]

UNIT-II

3. a) For the system represented in the given figure, determine transfer function C(S)/R(S). [7M]



b) Explain DC Servomotor and obtain its transfer function. [7M]

(OR)

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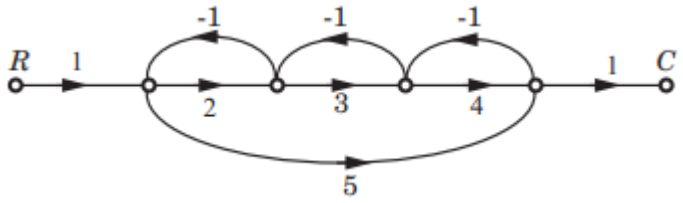
4. a) Find all the time domain specifications for a unity feedback control system whose open loop transfer function is given by G(S) = $\mathbf{25/\ S(S+5)}$. [7M]

   b) Find the overall transfer function of the system whose signal flow graph is shown below. [7M]



UNIT-III

5. a) With the help of Routh's stability criterion find the stability of the following system represented by the characteristic equation: [9M]

   $s^5 + s^4 + 2s^3 + 2s^2 + 3s + 5 = 0$

   b) List the limitations of Routh's stability. [5M]

(OR)

6. a) Using RH to determine the location of roots on the S-Plane and hence the stability for the system represented by the characteristic equation [7M]

$$S^6 + S^5 + 3S^4 + 3S^3 + 3S^2 + 2S + 1 = 0$$

   b) Sketch the root locus of the system whose open loop transfer function is G(s) H(s) = $\mathbf{K\ /\ S\ (S^2+4S+13)}$. [7M]

UNIT-IV

7. a) Sketch the Bode plot for the system having the following transfer function: $\mathbf{G(s) = \frac{15\ (S+5)}{S(S^2 + 16S + 100)}}$ [7M]

   b) Sketch the polar plot of the transfer function: [7M]

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

(OR)

8. a) Describe the Nyquist stability criterion and its significance. [7M]

   b) Build the Nyquist plot for a given transfer function: [7M]

$$G(s) = \frac{3}{s(1+5s)(1+2s)}$$

UNIT-V

9. a) Derive the expression for the transfer function of a lead-lag compensator. [7M]

   b) Define state transition matrix and explain its properties with examples. [7M]

(OR)

10. The state equations of a Linear system are as follows. [14M]

$$\dot{x} = \begin{bmatrix} -2 & 0 & 1 \\ 1 & -3 & 0 \\ 1 & 1 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} u \quad ; y = [2\ 1\ -1]\ x$$

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

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LINEAR CONTROL SYSTEMS

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Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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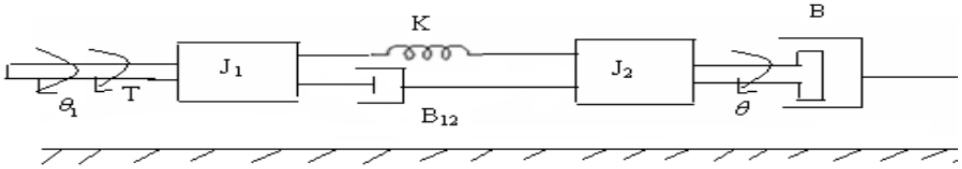
UNIT-I

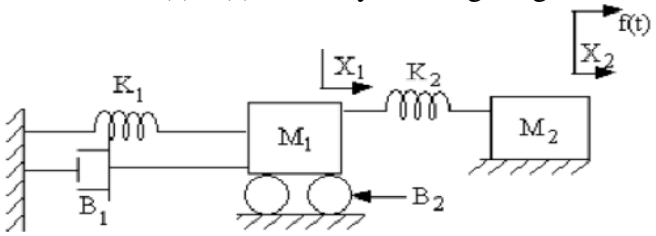
1. a) Write the differential equations governing the mechanical rotational system shown in the figure and find transfer function. [7M]



b) Explain about Traffic light control systems. [7M]

(OR)

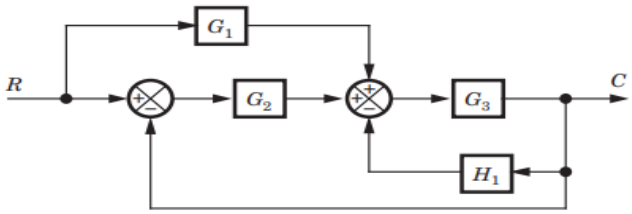
2. a) Find the transfer function X(s)/F(s) of the system Figure given below: [7M]



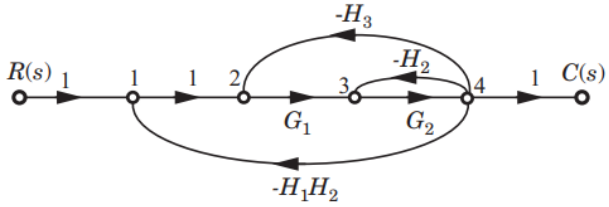
b) Derive the transfer function of rotational mechanical system. [7M]

UNIT-II

3. a) Determine the closed loop transfer function of control system shown below figure: [7M]



b) Find the overall transfer function of the system whose signal flow graph is shown below. [7M]



(OR)

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4. a) Describe the AC servo motor and list out its merits and demerits. [7M]

   b) List out the time domain specifications and derive the expressions for Rise time, Peak time and Peak overshoot. [7M]

UNIT-III

5. a) Determine the range of K for stability of unity feedback system whose open loop transfer function is G(s) H(s)= = $\mathbf{K} / \boldsymbol{S}(\boldsymbol{S}+\mathbf{1})(\boldsymbol{S}+\mathbf{2})$. Using Routh's stability criterion. [7M]

   b) With the help of Routh's stability criterion find the stability of the following system represented by the characteristic equation: [7M]
   $9s^5 - 20s^4 + 10s^3 - s^2 - 9s - 10 = 0$

(OR)

6. a) Explain the procedure for constructing root locus. [7M]

   b) Sketch the root locus of the system whose open loop transfer function is G(s) H(s) = $\mathbf{K} / \boldsymbol{S}(\boldsymbol{S}+\mathbf{2})(\boldsymbol{S}+\mathbf{4})$ [7M]

UNIT-IV

7. a) Sketch the Bode plot for the following transfer function G(s)H(s) = $\frac{K e^{-0.1s}}{S(S+1)(1+0.1S)}$ [7M]

   b) Sketch the polar plot for : [7M]
   $G(s) = \frac{1}{s(1+sT)}$

(OR)

8. a) Explain frequency domain specifications. [7M]

   b) A system is given by G(s) H(s) = $(\mathbf{4}\boldsymbol{S}+\mathbf{1}) / \boldsymbol{S}^2(\boldsymbol{S}+\mathbf{1})(\mathbf{2}\boldsymbol{S}+\mathbf{1})$ Sketch the Nyquist plot and determine the stability of the system. [7M]

UNIT-V

9. a) Explain PID Controllers with necessary expressions. [7M]

   b) Explain the controllability and observability with an example. [7M]

(OR)

10. The state equation of a system is given by: [14M]

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

i) Is the system controllable
ii) Compute the state transition matrix
iii) Compute $x_1(t)$ under zero initial condition and a unit step input.