R18

Code No: 155AR

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, January/February - 2023
CONTROL SYSTEMS
(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) What is the basic rule used for block diagram reduction technique? [2]
b) Write the force balance equation of an ideal mass, ideal dashpot and ideal spring element. [3]
c) List the time domain specifications. [2]
d) Define Centroid. How do you determine the centroid and angle of asymptotes in root locus technique? [3]
e) What is Polar plot? [2]
f) Define Phase Margin, Gain Margin with reference to Bode plot. [3]
g) What is the function of P and I Controllers? [2]
h) Define the terms Steady State Accuracy and transient accuracy of the system. [3]
i) Define Controllability. [2]
j) State the properties of state transition matrix. [3]

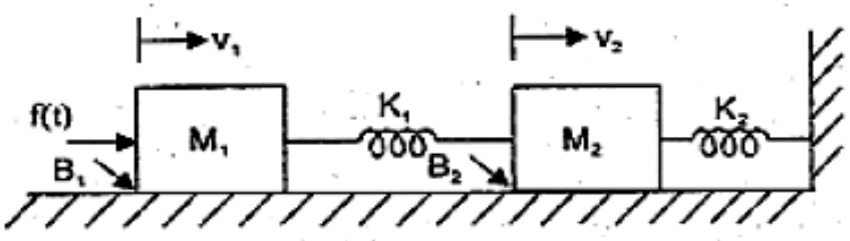
PART – B

(50 Marks)

2. Compare the Open loop and Closed loop Control Systems with examples in detail. [10]

OR

3. Determine the Force voltage and Force current analogy for given mechanical system. [10]



4. The characteristic polynomial of a system is $s^7+9s^6+24s^5+24s^4+24s^3+24s^2+23s+15=0$. Determine the location of roots on s-plane and hence the stability of the system. [10]

OR

5. Sketch the root locus of the system whose open loop transfer function is $G(s)=K/s(s+2)(s+4)$. Find the value of K so that the damping ratio of the closed loop system is 0.5. [10]

6. Sketch the polar plot for the following transfer function, Determine phase margin and gain margin. [10]

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

OR

7. Sketch the Bode plot of the given system and determine the phase margin and gain margin of the system. [10]

$$G(s) = \frac{20\,(0.1s+1)}{S^2(0.2s+1)(0.02s+1)}$$

8. Explain the step by step procedure of Root-loci method of feedback controller design. [10]

OR

9. Discuss the Analog and Digital implementation of controllers. [10]

10. Consider a system with state model given below:

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -1 \end{bmatrix} X + \begin{bmatrix} 0 \\ 5 \\ -24 \end{bmatrix} u;\ y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \end{bmatrix} u$$

Verify, the system is observable and controllable. [10]

OR

11. Explain about diagonalization and also obtain the state model of the given transfer function [10]

$$\frac{Y(S)}{U(S)} = \frac{5}{s^2+6s+7}$$

---ooOoo---

Code No: 155AR **R18**

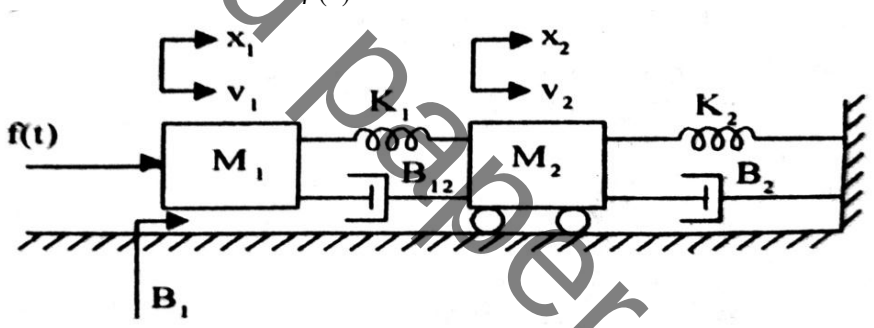
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, August - 2022
CONTROL SYSTEMS
(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Explain the difference between open loop and closed loop system.
b) Define transfer function and derive an expression for the transfer function of a closed loop system with a unity feedback. [7+8]

2.a) Determine transfer function $\frac{X_2(s)}{f(s)}$ for a given mechanical system shown below:



b) What is the effect of feedback? [10+5]

3.a) An experiment conducted on a servo mechanism shows the error response to be
$e(t) = 1.4\, e^{-4t} \sin(2.86t + 43^0)$
Where the input is a sudden unit displacement. Determine the natural frequency, damping ratio and damped angular frequency of the system.
b) Construct Routh Array and determine the stability of the system whose characteristic equation is $S^6+2S^5+8S^4+12S^3+20S^2+16S+16=0$. Also determine the number of roots lying on right half of s-Plane, left half of s-plane and on imaginary axis. [7+8]

4. What is break away and break in points? A unity feedback system has on open loop transfer function $U(s) = \frac{K}{s(s^2+6s+10)}$. Find its break away and break in points. [15]

5. Plot the bode diagram for the fallowing Transfer function and obtain the gain and phase crossover frequencies. [15]

$$G(S) = \frac{10}{S(1+0.4S)(1+0.1s)}$$

6.a) Define gain margin and phase margin.

b) Explain relation between time and frequency response analysis. [5+10]

7. What is compensation? What are the different types of compensators? Explain in brief. [15]

8.a) Obtain the state transition matrix for the state model whose matrix A is given by

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

b) Consider the system $\dot{X}$ = AX + Bu ,Y = CX

Where A = $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ C =$\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$

Test for controllability and observability. [7+8]

---oo0oo---

Code No: 155AR **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, February - 2022
CONTROL SYSTEMS
(Common to ECE, EIE)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) With a neat closed loop block diagram, explain automobile driving system.
b) Compare and contrast open loop and closed loop system. [8+7]

2.a) With a neat closed loop block diagram explain temperature control system.
b) Explain the benefits of feedback system. [8+7]

3. Find stability of the following system with characteristic equation using Routh Hurwitz criterion [15]

$$2s^4+s^3+3s^2+5s+10=0$$

4. Elucidate Root Locus techniques with suitable example. [15]

5. Draw Nyquist plot for the system having following characteristics equation. [15]

$$Ks^3+(2K+1)s^2+(2K+5)s+1=0$$

6. Draw Bode plot for the system with the following transfer function. [15]

$$L(s)=\frac{2500}{s(s+5)(s+50)}$$

7. The transfer function of a lag-lead compensator is given by

$$D(s)=\underbrace{\left[\frac{\tau_1 s+1}{\beta\tau_1 s+1}\right]}_{\text{Lag Section}}\underbrace{\left[\frac{\tau_2 s+1}{\alpha\tau_2 s+1}\right]}_{\text{Lead Section}};\ \beta>1,\ \alpha<1,\ \tau_1,\ \tau_2>0$$

Give an op amp circuit that realizes this D(s). [15]

8. A system is given by the state equation

$$\dot{\mathbf{x}}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & 0 & -3\end{bmatrix}\mathbf{x}+\begin{bmatrix}0\\0\\1\end{bmatrix}u\ ;\ \mathbf{x}(0)=\mathbf{x}^0$$

Using Laplace transform technique, transform the state equations into a set of linear algebraic equations. [15]

---ooOoo---

Code No: 155AR **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2021
CONTROL SYSTEMS
(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) List the differences between open loop and closed loop systems with suitable examples.
b) Obtain the transfer function $\frac{\theta(s)}{V_a(s)}$ for armature controlled dc servomotor. [8+7]

2.a) What is meant by time response? Explain about (i) Steady- state response (ii) Transient response.
b) Find the steady-state error for unit step, unit ramp and unit acceleration inputs for the following systems.
i) 10/ s(0.ls + 1)(0.5s + 1)
ii) 1000/ s^2(s + 1)(s +20) [8+7]

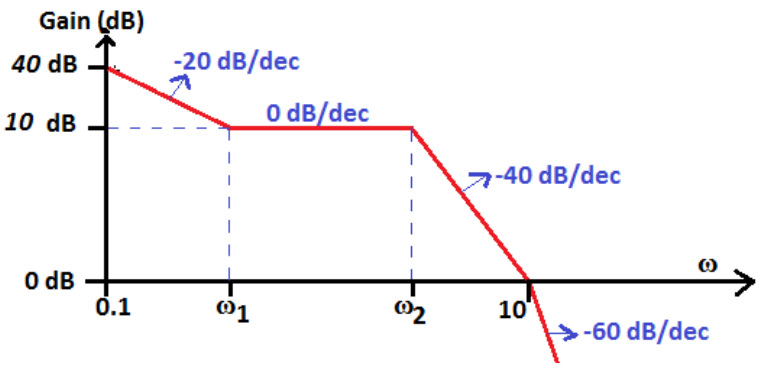
3.a) List the properties of root locus and sketch the root locus of the unity feedback system with

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

b) A unity feed-back system is characterized by an open loop T.F G(s) = 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 Ts, Tp and Mp for a unit step input. [8+7]

4.a) Explain clearly the steps involved in the construction of Bode plots of a system with loop transfer function consisting of
i) An open loop gain K
ii) One pole at origin
iii) One quadratic factor.
b) State and explain Nyquist Stability Criterion. [8+7]

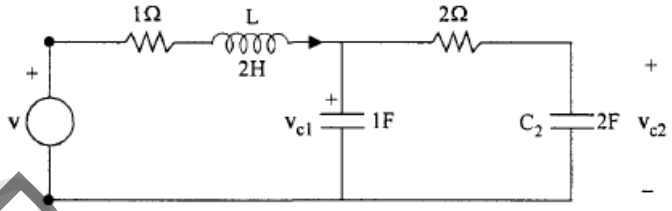
5. What is Phase Margin and gain margin? Determine the transfer function whose Bode diagram is given by [15]



6. Discuss the procedural steps of lag compensation design in frequency domain. [15]

7.a) Define the terms: i) State variable ii) State transition matrix.

b) Obtain the state space representation of the electrical system shown below.



Take $x_1=i_L$, $x_2=vc_1$, $x_3=vc_2$ v=u and y= vc_2 [6+9]

8.a) An LTI system is characterized by the homogeneous state equation:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}1\\ 0\end{bmatrix} u$$

Compute the solution of the homogeneous equation assuming the initial state vector $X_0 = \begin{bmatrix}1\\ 0\end{bmatrix}$

b) The system is represented by the differential equation $\ddot{y}+5\dot{y}+6y=u$. Find the transfer from state variable representation. [8+7]

---ooOoo---

Code No: 155AR **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, September - 2021

CONTROL SYSTEMS

(Common to ECE, EIE)

Time: 3 Hours **Max. Marks: 75**

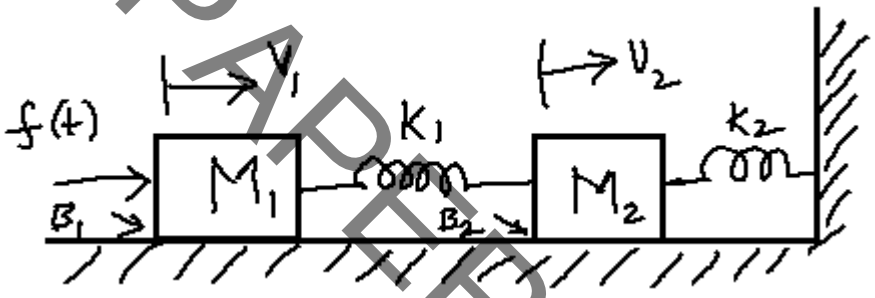
Answer any five questions

All questions carry equal marks

\- - -

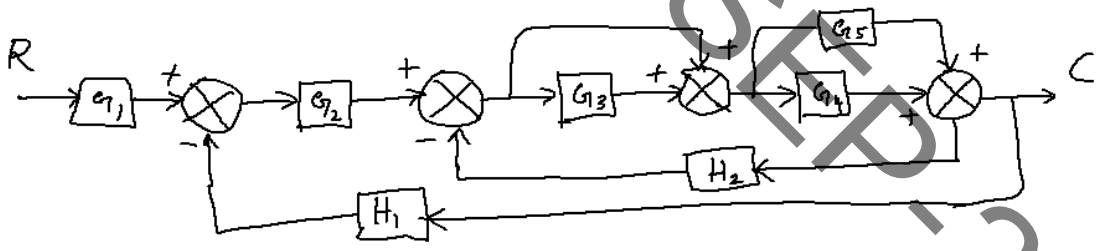
1.a) Explain the benefits of feedback in detail.

b) For the mechanical system below, derive the transfer function, f(*t*) is the input, where as V_2 is output. [6+9]



2.a) What are the basic blocks used in mathematical modeling of rotational systems? Explain.

b) Using block diagram algebra, determine C/R. [6+9]



3.a) Discuss about initial and final value theorems used in time response analysis.

b) Using Routh criterion, determine the stability of the system whose characteristic equation is given by [6+9]

$$9s^5 - 20s^4 + 8s^3 - 8s^2 - 6s + 5 = 0$$

4. Explain different steps involved in construction of root-loci. [15]

5.a) How to draw bode plot? Explain.

b) Sketch the polar plot of the following transfer function. [6+9]

$$G(s) = \frac{10(1+s)}{(2+s)(4+s)}$$

6.a) How to find Relative stability using Nyquist criterion? Explain.

b) Sketch the bode plot of the following open loop transfer function. [6+9]

$$G(s) = \frac{50(1+0.1s)}{(1+0.01s)(1+s)}$$

7. Explain about Root-loci method of feedback controller design. [15]

8.a) Determine the state and output equations in vector matrix form for the system whose transfer function is given by

$$G(s) = \frac{(s+2)}{s(s^2+8s+11)}$$

b) Verify whether the following system is observable or not. [8+7]

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 0 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

---ooOoo---