R22

Code No: 185BE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, January - 2025
CONTROL SYSTEMS
(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 60**

Note: This question paper contains two parts A and B.
i) Part- A for 10 marks, ii) Part - B for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of ten questions (numbered from 2 to 11) carrying 10 marks each. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART- A

(10 Marks)

1.a)	What is meant by non- linear system?	[1]
b)	Define the transfer function.	[1]
c)	Define the order of the system.	[1]
d)	State the Routh's criterion.	[1]
e)	What is polar plot?	[1]
f)	Define the gain margin.	[1]
g)	Define the steady-state accuracy.	[1]
h)	What is the need of PD controller?	[1]
i)	Define state variable.	[1]
j)	Define observability.	[1]

PART - B

(50 Marks)

2.a) What are the limitations of open loop systems? List the advantages of closed loop system over open loop systems.

b) The mechanical system consisting of two discs which have damping between them and also between each of them and the frame is shown in figure 1. For this system, (i) draw the equivalent mechanical network, (ii) write the performance equations and (iii) draw analogous electric network. [4+6]

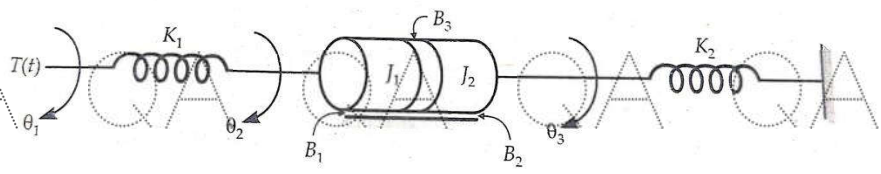

Figure 1

OR

3.a) Reduce the block diagram shown in figure 2 and find the input-output relationship ratio $\frac{C}{R}$.

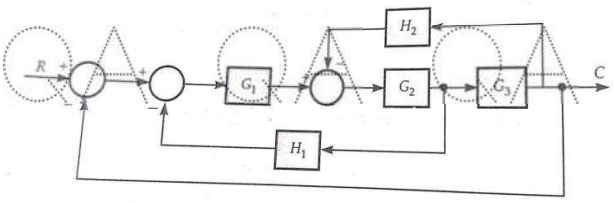

Figure 2

b) Explain the AC Servomotor and develop its block diagram. [5+5]

4.a) Determine the response of second order system with unit step input.

b) A unity feedback system is characterized by the open loop transfer function $G(s) = \frac{3}{s(1+0.4s)(1+0.6s)}$. Determine the steady state error for unity step, unity ramp and unity acceleration inputs. [6+4]

OR

5.a) What are the necessary and sufficient conditions of stability for linear time invariant systems?

b) A feedback system has the open loop transfer function of G(s) = $\frac{Ke^{-s}}{s(s^2+3s+6)}$. Find the limiting values of K for maintaining stability. [4+6]

6.a) Derive the expressions for frequency domain specifications.

b) Given the open loop transfer function with unity feedback as G(s) = $\frac{75(1+0.2s)}{s(s^2+16s+50)}$. Draw the bode plot. [4+6]

OR

7.a) Explain the procedure to draw the polar plot.

b) Given the open loop transfer function G(s)= $\frac{30}{(1+s+s^2)(1+2s)}$ .Sketch the Nyquist plot and investigate the open loop and closed loop systems stability. [4+6]

8.a) Explain the analog and digital implementation of controllers.

b) What is the need of lag compensator? Derive its transfer function and draw the bode plot. [4+6]

OR

9. Design a phase lag network for a plant with the open loop transfer function G(s)= $\frac{20}{s(1+0.2s)^2}$ to have a phase margin of 45^0. Verify the performance of the compensated system with the specification. [10]

10. A system is characterized by the following state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t),\ t>0$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

a) Determine the state transition matrix

b) Solve the state equation for a unit step input under zero initial condition. [5+5]

OR

11.a) Determine the state controllability and observability of the following system having matrices of the state space equations.

$$A = \begin{bmatrix} -1 & 0 \\ 0 & -4 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad C = \begin{bmatrix} 1 & 3 \end{bmatrix}$$

b) Describe the design of state feedback controllers through pole-placement. [5+5]

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