Code No: 134AM **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year II Semester Examinations, February -2024

CONTROL SYSTEMS

(Common to EEE, 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 do you mean by a closed-loop control system? [2]
b) What are characteristics of negative feedback? [3]
c) Why are test signals needed? [2]
d) Name and define the static error coefficients. [3]
e) What is conditional stability? [2]
f) Define Phase margin and phase cross over frequency. [3]
g) What is a lag-lead compensator? [2]
h) How polar plots are useful in finding the stability of a system [3]
i) How do you obtain the characteristic equation of a system from its state model? [2]
j) State the properties of state transition matrix. [3]

PART – B

(50 Marks)

2.a) State Masons's gain formula.
b) Obtain the closed loop transfer function $C(s)/R(s)$ of the system whose block diagram is shown in figure 1. [3+7]

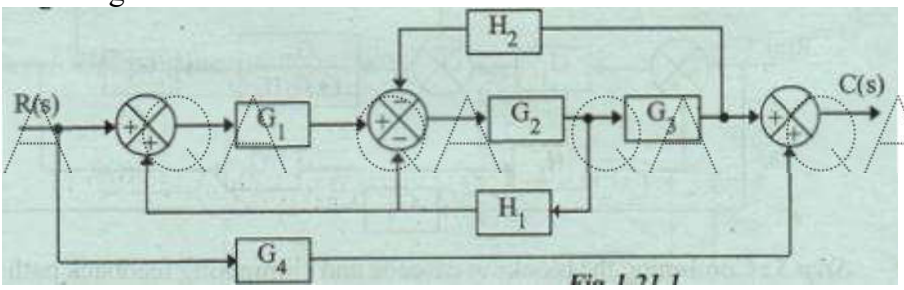

Figure 1

OR

3.a) Write the differential equations governing the mechanical rotational system shown in figure 2 and determine the transfer function $\theta(s)/T(s)$.

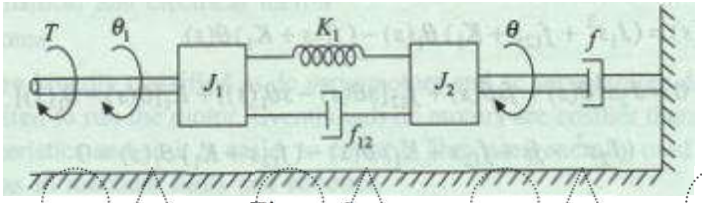

Figure 2

b) Compare the AC and DC servomotor. [7+3]

4.a) What is the effect of a PD controller on the system performance?

b) The open loop transfer function of a unity feedback system is $G(s) = \frac{10}{S(S+4)}$. Determine the nature of response of the closed loop system for a unit step input. Also determine the rise time, peak time, peak overshoot and setting time. [2+8]

OR

5.a) What is the effect of a PI controller on the system performance?

b) For a unity feedback control system, the open loop transfer function $G(s) = \frac{10(S+2)}{S^2(S+1)}$.

Find the position, velocity and acceleration error constants. [2+8]

6. Sketch Bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec. $G(s) = \frac{KS^2}{(1+0.2S)(1+0.02S)}$. [10]

OR

7. Sketch the root locus of the system whose open loop transfer function is $G(S) = \frac{K}{S(S+2)(S+4)}$. Find the value of K so that the damping ratio of the closed loop system is 0.5. [10]

8. The open-loop transfer function of a type-2 unity feedback system is $G(s) = \frac{K}{S^2(1+0.2S)}$

Design a suitable compensator to meet the following specifications Acceleration error constant $K_a = 10$, phase margin $\emptyset_m = 30^0$. [10]

OR

9. Sketch the polar plot of a system given by $G(s) = \frac{1}{s(1+s)(1+2s)}$ If the plot crosses the real axis determine the corresponding frequency and magnitude. [10]

10.a) Explain the concept of diagonalization.

b) Obtain the state transition matrix for the state model whose A matrix is given by $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. [3+7]

OR

11.a) Given its state model, how can you determine the stability of a system.

b) Obtain the stat variable model in phase variable form for the following system $\ddot{y} + 8\dot{y} + 12 = u(t)$. [3+7]

--ooOoo--