Total number of printed pages: 3 **D/4th Semester/DIE404**

2025

CONTROL SYSTEMS

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. a) Define control systems. Explain the difference between open loop and closed loop control system with examples. 1+5=6

   b) Define the following terms:
   (i)System (ii) Plant (iii) Controller 2X3=6

   c) Explain Servomechanism with the help of a suitable example 6

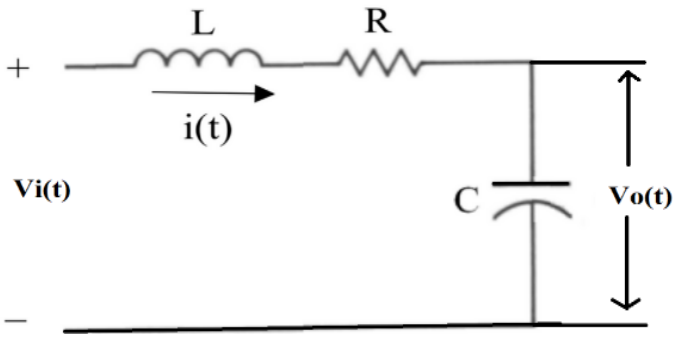
   d) What is an error detector in control system? 2

2. a) If the system transfer function is $\frac{Y(s)}{X(s)} = \frac{s+4}{s^2+2s+5}$. Obtain the differential equation representing the system. 4

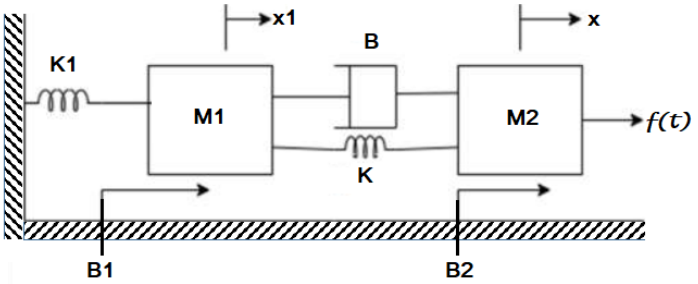
   b) The unit impulse response of a system is e^{-7t}. Find its transfer function. 2

   c) The transfer function of a system is given by $G(s) = \frac{K(s+6)}{s(s+2)(s+5)(s+3)(s+4)}$.
   Determine (i) Poles (ii) Zeros (iii) Characteristics equation and (iv) Pole-Zero plot in s-plane. 7

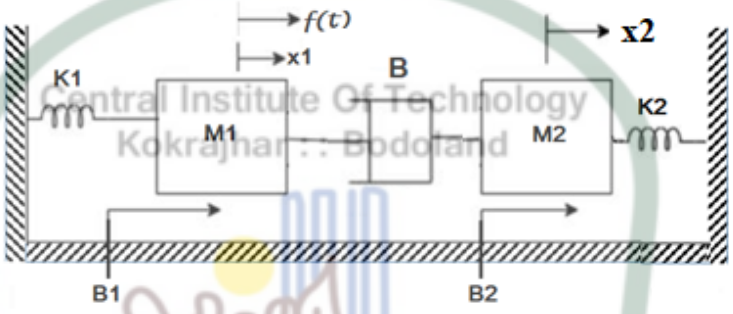
   d) Find out the transfer function of the network given below 7



3. a) Write the differential equation governing the mechanical system in figure and determine the transfer function. (10)



b) Draw the equivalent mechanical system of the figure shown below. Hence write the set of equilibrium equations and obtain electrical analogous circuits using F-V analogy and F-I analogy. (10)



4. a) Name the basic elements of block diagram. Give advantage of block diagram reduction technique. 4

b) The transfer functions of the blocks connected in series get _____.

(i) Algebraically Added (ii) multiplied (iii) subtracted (iv) divided 1

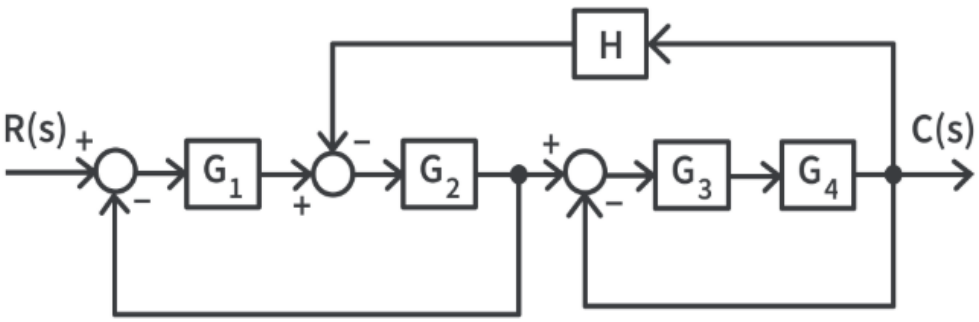
c) The transfer functions of the blocks connected in parallel get _____. 1

(i) Algebraically Added (ii) multiplied (iii) subtracted (iv) divided

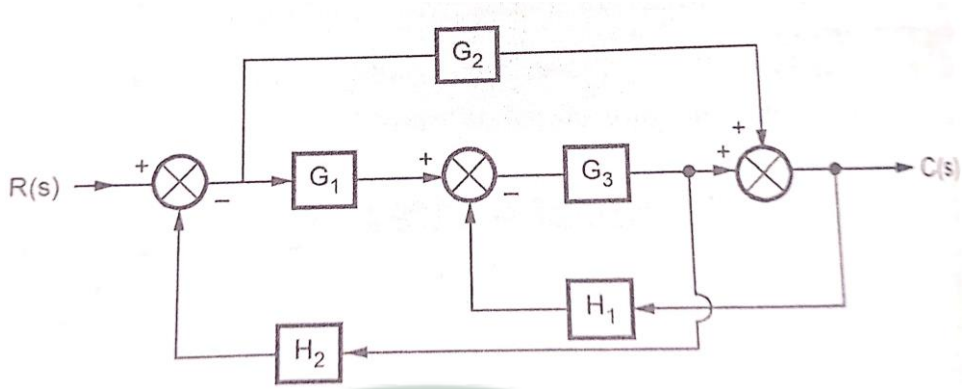
d) Write the rule for eliminating negative feedback loop. 3

e) Transfer function of the system is defined as the ratio of Laplace output to Laplace input considering initial conditions_____. 1

f) Reduce and obtain the transfer function of the given system 10



5. a) Draw signal flow graph of the system shown below and obtain overall system transfer function using Mason's gain formula. 10



b) Derive the expressions for static error coefficients. 10

6. a) A unity feedback system has $G(s) = \frac{40(s+2)}{s(s+1)(s+4)}$ .Determine (i) Type of the system (ii) All error coefficients and (iii) Error for input with magnitude 4. 5

b) What is damping ratio? State the conditions for damping ratio. 5

c) Define Rise Time and Peak Time. 4

d) By means of Routh criterion, determine the stability of the system described by characteristic equations: $3s^4+10s^3+5s^2+5s+2=0$ 6

7. a) Sketch the root locus of unity feedback system with an open loop transfer function as K varied from 0 to α. $G(s)H(s) = \frac{K}{s(s+2)(s+3)}$ 10

(b) Explain the following: 5+5=10

(i) Parameters of Bode Plot (ii) Steady State error