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08 PALAKKAD CLUSTER

Q. P. Code : IAR0820131-I (Pages: 3)

Name: .....

Reg. No: .....

FIRST SEMESTER M.TECH. DEGREE EXAMINATION MARCH 2021

Branch: Mechanical Engineering **Specialization: Industrial Automation and Robotics**

08ME6331 Advanced Control Systems

Time: 2 hour 15 minutes **Max. Marks: 60**

Answer all six questions.

Modules 1 to 6: Part 'a' of each question is compulsory and answer either part 'b' or part 'c' of each question.

Q. No.	Module 1	Marks
1. a	What do you mean by closed loop system? Illustrate with an example.	3

Answer b or c

b	Find the overall transfer function of the system shown in Fig.1 by using Mason's gain formula.	6

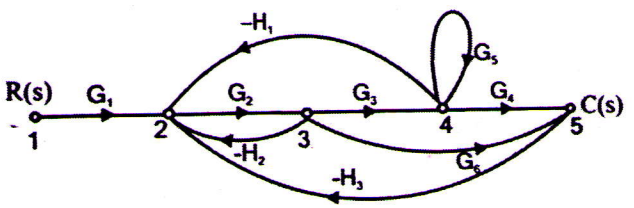

Fig. 1

c	Obtain the transfer function of the mechanical system shown in Fig. 2	6

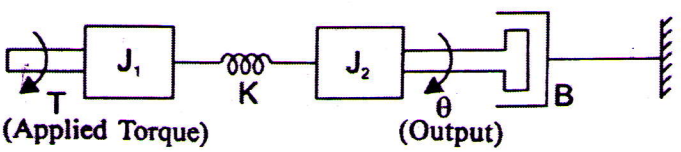

Fig. 2

Q. No.	Module 2	Marks
2. a	What is steady state error? What are static error constants?	3

Answer b or c

b Consider a unity feedback system with a closed loop transfer function **6**

$$\frac{C(S)}{R(S)} = \frac{Ks + b}{s^2 + as + b}$$

Determine the open loop transfer function $G(s)$. Show that the steady state error with unit ramp input is given by $\frac{(a-K)}{b}$

c Derive the expression for time response of an underdamped second order system. **6**

Q. No.	Module 3	Marks
3. a	What is Bode plot? What are the advantages of Bode plot?	**3**

Answer b or c

b Using Routh Criterion, determine the stability of the system represented by the characteristic equation: **6**

$$S^4 + 8S^3 + 18S^2 + 16S + 5 = 0$$

Comment on the location of the roots of characteristic equation.

c The open loop transfer function of a unity feedback system is given by: **6**

$$G(s) = \frac{K(s+9)}{S(S^2 + 4S + 11)}$$

Sketch the root locus of the system.

Q. No.	Module 4	Marks
4. a	What are the advantages of state space modelling over transfer function model method?	**3**

Answer b or c

b Construct the state model of the mechanical system shown in Fig. 3 **6**

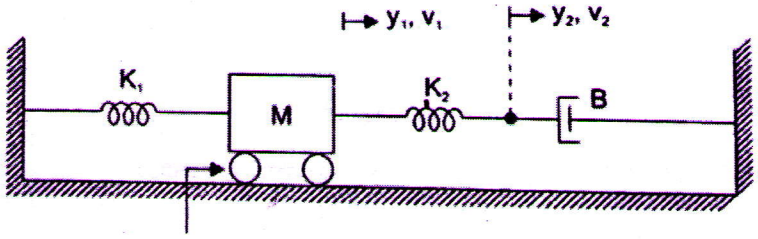

Fig. 3

c Construct a state model for a system characterized by the differential equation, 6

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 6y + u = 0$$

Q. No.	Module 5	Marks
5. a	Define observability. State the condition for observability by Kalman's method.	4
	Answer b or c	
b	Given the system matrix, $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ Compute the state transition matrix.	8
c	Determine the state controllability for the system represented by the following state equation: $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$	8

Q. No.	Module 6	Marks
6. a	Write a short note on PI and PID controllers.	4
	Answer b or c	
b	With the neat block diagram, explain the force control of a single mass.	8
c	With suitable block diagram and equations, explain the PID control of a single link manipulator.	8