Course Code: 1940206 Roll No: MLRS-R19

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
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II B.Tech II Sem Supply End Examination, July 2022
Control Systems
(EEE)

Time: 3 Hours. **Max. Marks: 70**

Note: 1. Question paper consists: Part-A and Part-B.
2. In Part – A, answer all questions which carries 20 marks.
3. 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

(10*2 Marks = 20 Marks)

1.	a)	List the advantages and disadvantages of open loop control systems	2M	CO1	R
	b)	Mention the analogue electrical quantities for the mass, damper and spring elements of a mechanical system in force-voltage analogy	2M	CO1	U
	c)	List out the time domain specifications of a second order system	2M	CO2	R
	d)	What is centroid? How the centroid is calculated?	2M	CO2	R
	e)	Define gain crossover frequency and phase crossover frequency	2M	CO3	R
	f)	What is polar plot?	2M	CO3	R
	g)	Write the features of lead compensator	2M	CO4	U
	h)	What is the effect of PI controller on the system performance?	2M	CO4	U
	i)	Summarize the concept of observability with reference to the kalman's test	2M	CO5	R
	j)	What is the significance of state transition matrix?	2M	CO5	U

PART- B

(10*5 Marks = 50 Marks)

2 Consider the mechanical translational system shown in Fig.1. 10M CO1 Ap

(i) Identify the displacements of masses and write the equations that describing the motion.

(ii) Obtain the transfer function X1(s)/ F(s).

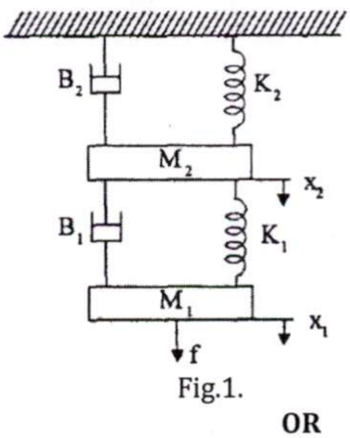


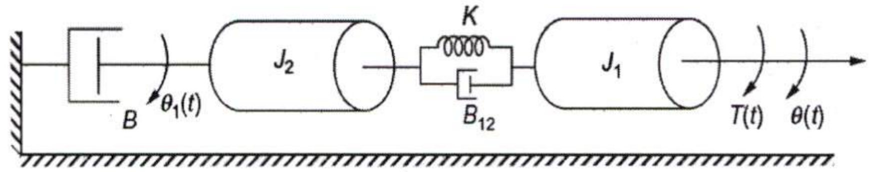
Fig.1.

OR

3 For the mechanical rotational system shown in Fig.3. 10M CO1 Ap

(i) Draw the Torque–Voltage electrical analogous circuit.

(ii) Draw the Torque -Current electrical analogous circuit



4 a) Obtain the response of a unity feedback system whose open-loop transfer function is $G(s) = \frac{3}{s(s+4)}$ for a unit-step input. — 5M CO2 Ap

b) A physical system characteristic equation is represented by a sixth order equation as, $s^6 + 2s^5 + 8s^4 + 13s^3 + 20s^2 + 16s + 16 = 0$. Using Routh stability criterion, find whether the system is stable or not, give the reasons. — 5M CO2 Ap

OR

5 Sketch the root locus plot for the system represented through $G(s)H(s) = \frac{K}{s(s+2)(s+6)}$. From the obtained root locus plot, estimate the range of values of the system gain 'K' for which the system is –
(a) Absolutely stable (b) Marginally stable (c) Unstable — 10M CO2 Ap

6 The open loop transfer function of a unity feedback system is given by $G(s) = 1/[s(1+s)(1+2s)]$. Sketch the polar plot and determine the gain margin and phase margin. — 10M CO3 Ap

OR

7 Sketch the Bode plot for the following transfer function and obtain the gain and phase cross over frequencies — 10M CO3 Ap

$$G(s) = 10/[s(1+0.4s)(1+0.01s)].$$

8 What is a lag compensator? Obtain the transfer function of a lag compensator from its equivalent electrical circuit and draw the pole-zero plot. — 10M CO4 Ap

OR

9 Compensate the system with the open-loop transfer function $G_f(s)=k/[s(0.5s+1)(0.1s+1)]$ to meet the following specifications i)damping ratio=0.5 ii) T_s=8s iii) velocity error constant K_v>8s — 10M CO4 An

10 a) The dynamics of a physical system is described by the differential equation $\frac{d^3y}{dt^3} + 2\frac{d^2y}{dt^2} + 5\frac{dy}{dt} + 7y = 4u$. Assume appropriate state variables and construct its state model. — 5M CO5 Ap

b) A linear time invariant system is characterized by the homogeneous state equation, — 5M CO5 Ap

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \quad x0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}.$$

Compute the solution of the homogeneous equation assuming the initial state vector

OR

11 A dynamical system is represented through the state model as indicated below. — 10M CO5 Ap

$$\dot{X}(t) = \begin{bmatrix} 0 & 2 & 0 \\ 1 & 2 & 0 \\ -1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u(t) \quad and \quad Y(t) = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Investigate whether the given system is completely state controllable and observable. Also, comment on the stability of the system.

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