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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; August - 2023

Control Systems

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply mathematical knowledge to determine the Transfer function of a system

CO2: Analyze the stability of a system using different techniques

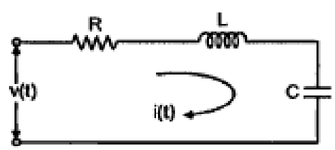
CO3: Analyze the response of the system in time and frequency domain and state variable techniques

CO4: Develop the mathematical models using different techniques of state variables

CO5: Design Using MATLAB software for the linear control system problems.

***Note: I) PART - A** is compulsory. **Two** marks for each question.*

***II) PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	Write the Laplace transform of voltage equation for the given circuit. 	2	L1	CO1	PO1
b.	Explain the concept of maxima theorem in this case. $\left.\frac{dc(t)}{dt}\right\|_{t=T_p} = 0$	2	L2	CO2	PO2
c.	How many minimum breakaway points exist for the given, $G(s)=\frac{K(s+6)}{s(s+2)(s+4)}$.	2	L3	CO2	PO2
d.	List any two advantages of Nyquist Plot.	2	L1	CO3	PO2
e.	Define State and State space.	2	L2	CO4	PO2
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	Draw the equivalent mechanical system of the given system. Obtain electrical analogous circuits using, i) F-V Analogy ii) F-I Analogy	9	L3	CO1	PO1

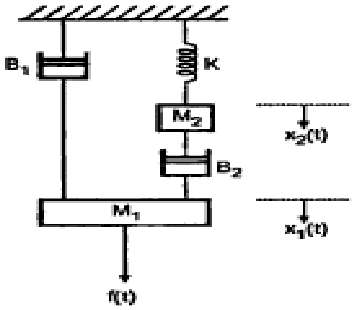


Fig. 2a

b. Obtain the transfer function for the block diagram in Fig. 2b. 9 L4 CO1 PO1

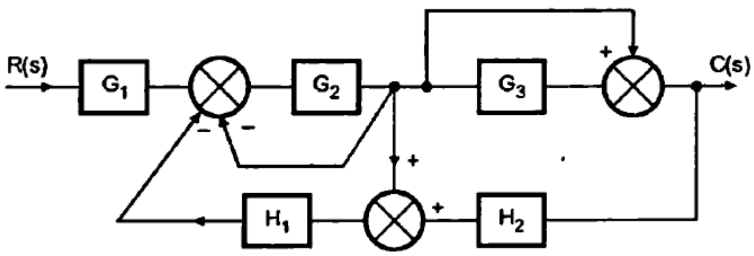


Fig. 2b

c. Find the transfer function for the signal flow graph shown in Fig. 2c. 9 L4 CO1 PO1

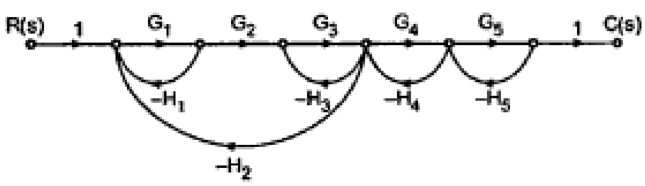


Fig. 2c

UNIT - II **18**

3 a. Derive the expression for peak time T_p and settling time T_s for the second order control systems. 9 L3 CO3 PO2

b. The control system is shown in the Fig. 3b. If the input to the system is,
i) Unit step ii) Unit ramp, Find e_{ss} 9 L3 CO3 PO2

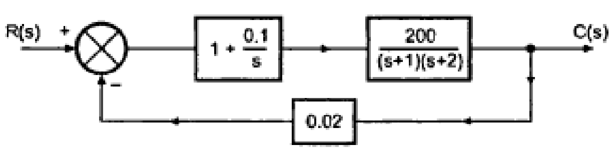


Fig. 3b

c. Find the value of K_1 and K_2 in the Fig. 3c given peak time is 2 seconds and settling time 5 seconds(assume 2% tolerance band). 9 L3 CO3 PO2

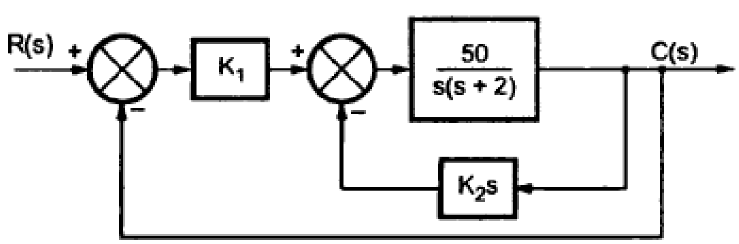


Fig. 3c

UNIT - III **18**

4 a. Check the stability of the given characteristic equation using RH criterion. 9 L4 CO2 PO2

$$s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$$

b. Demonstrate the rules to plot root locus with an example. 9 L2 CO2 PO2

c. Sketch the complete root locus of system having $G(s)H(s) = \dfrac{K}{s(s+1)(s+2)(s+3)}$ 9 L5 CO2 PO2

UNIT - IV **18**

5 a. Given, $G(s)H(s) = \dfrac{K}{s(s+2)(s+10)}$, sketch the Nyquist plot and hence calculate the range of values of K for stability. 9 L5 CO2 PO2

b. Sketch the Bode plot for following transfer function. 9 L5 CO2 PO2

$$G(s) = \frac{Ks^2}{(1+0.2s)(1+0.002s)}$$

c. Write a note on Nyquist stability criterion and list the steps to solve Nyquist Criterion problems. 9 L2 CO2 PO2

UNIT - V **18**

6 a. Obtain the model of the given electrical system in Fig 6a 9 L5 CO4 PO2

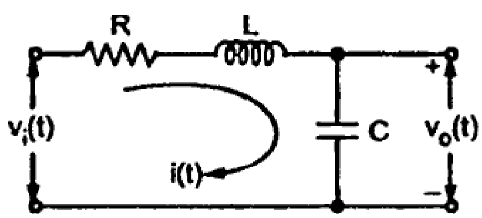


Fig 6a

b. Find the state transition matrix for, 9 L3 CO4 PO2

$$A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$$

c. Obtain the solution of the homogeneous state equation. 9 L3 CO4 PO2

$$\dot{X} = AX \text{ where } A = \begin{bmatrix} 1 & -2 \\ 1 & -4 \end{bmatrix} \text{and } X(0) = \begin{bmatrix} 0.5 \\ 1 \end{bmatrix}$$

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