U.S.N

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; July / Aug. - 2022

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.

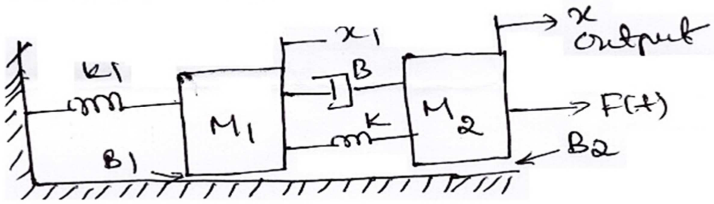
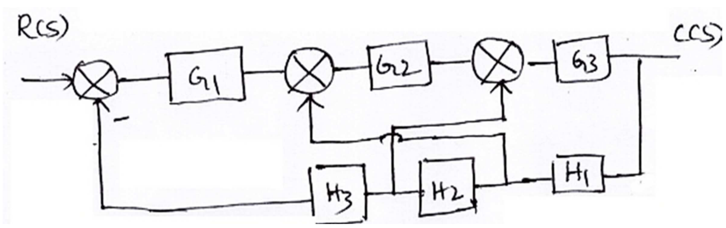
CO3 – Analyze the response of the system in time and frequency domain and state variable techniques.

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**			
I a.	Compare open loop and close loop control systems.	2	L1	CO1	PO1
b.	How are control systems classified depending on the value of damping?	2	L1	CO3	PO1
c.	What is difficulty 1 in root locus method and how it can be overcome?	2	L1	CO2	PO1
d.	What is frequency response? What are the frequency domain specifications?	2	L1	CO3	PO1
e.	Define state and state variable.	2	L1	CO4	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	For the mechanical system shown in Fig. 1(a); i) Draw the mechanical network ii) Write the deferential equations governing the system iii) Draw the F-V electrical circuits with the corresponding electrical equations  Fig.1(a)	9	L3	CO1	PO2
b.	Find the overall transfer function $\frac{C(s)}{R(s)}$ for the block diagram shown in Fig. 1(b). 	9	L3	CO1	PO2

c. Find the overall transfer function $\frac{C(s)}{R(s)}$ for the signal flow graph shown in Fig. 1(c). — 9 L3 CO1 PO2

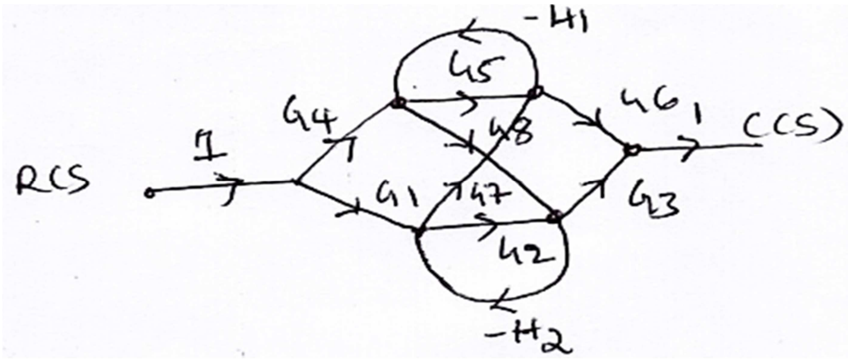


Fig.1(c)

UNIT - II **18**

2 a. Derive the expression for unit step response of underdamping second order system. — 9 L3 CO2 PO2

b. A system is given by differential equation $\frac{d^2y}{dt^2}+6\frac{dy}{dt}+25y=25x$, Where y = output and x = input. Determine all time domain specifications for unit step input. — 9 L3 CO2 PO2

c. A Unity feedback system has $G(s) = \frac{50}{S(s+5)}$ find the following: — 9 L3 CO2 PO2

i) Percentage overshoot for a unit step input.

ii) Settling time for a unit step input

iii) Steady state error for an input by the polynomial

$r(t) = 2 + 4t + 6t^2, t > 0$

UNIT - III **18**

3 a. Explain briefly the Routh-Hurwitz criterion and use it to determine the roots, i) in RHS ii) in LHS iii) On jω axis of S plane for polynomial $S^6 + S^5 + 5S^4 + S^3 + 2S^2 - 2S - 8$ — 9 L3 CO3 PO2

b. A unity feedback system control system has $A = \pi r^2$G(s)=$\frac{K(s+13)}{S(s+3)(s+7)}$. Using Routh's criterion, calculate the range of *k* for which system: — 9 L3 CO3 PO3

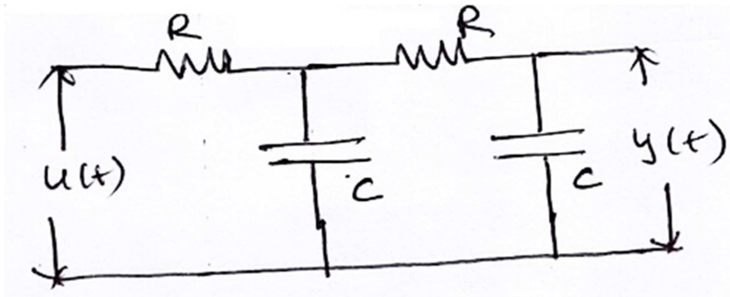
i) Stable ii) Has its close loop poles more negative than −1.

c. Sketch the root locus plot for G(s) = *k* | s (s+3) (s+5) and determine the value of *k* for ε = 0.6. — 9 L3 CO3 PO3

UNIT - IV **18**

4 a. Explain the terms phase margin and gain margin as related to polar plot and concept of encirclement and Nyquist creation. — 9 L2 CO3 PO2

b. For a unit feedback system G(s) =24$\frac{2\,(s+5)}{S\,(s+1)(s^2+5s+121)}$sketch Bodeplot and find(i) (ii) gain margin and phase margin — 9 L3 CO3 PO3

c.	Sketch the Nyquist plot and find the range of k for closed loop stability for the loop transfer function G(s) H(s) $=\frac{k}{S\,(s+2)(S+10)}$.	9	L3	CO3	PO3
	UNIT - V	**18**			
5 a.	Obtain state model for a system as shown in Fig. 5(a).  Fig.5(a)	9	L3	CO1	PO2
b.	Obtain the state transition matrix for the following system, $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}=\begin{bmatrix} -1 & -0.5 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}+\begin{bmatrix} 0.5 \\ 0 \end{bmatrix}u$	9	L2	CO2	PO2
c.	A single input single output system has the state and output equations, $x^1=\begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix}x+\begin{bmatrix} 0 \\ 1 \end{bmatrix}u$ y = [50] x i) Determine its transfer function ii) Find its state transition matrix	9	L2	CO3	PO2

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