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

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Mechanical Engineering

Semester End Examination; February - 2022

Automatic Control Engineering

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1- Classify the different types of control systems. Develop mathematical model for the mechanical, electrical, servo mechanism and hydraulic systems.

CO2- Make use of block diagrams and signal flow graphs to represent the systems consisting of number of components, Develop mathematical models using reduction technique of these block diagrams and signal flow graphs.

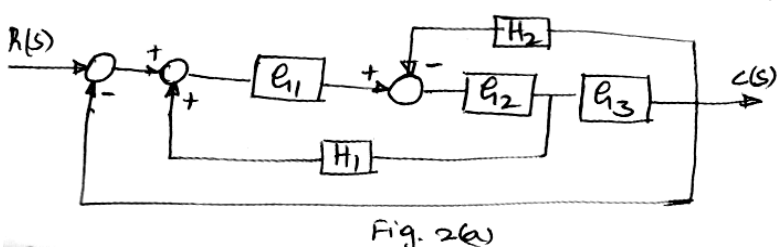
CO3- Analyze the time response and steady-state error of the system. Explain different types of controllers.

CO4- Determine stability of the various control systems by applying Routh's stability criterion. Analyze frequency response of control system using Nyquist stability criterion and Bode plot.

CO5- Construct root loci from open loop transfer functions of control systems and Analyze the behavior of roots with system gain. Analyze complex systems having multi inputs and multi outputs using state-space method.

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

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

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	What are the basic elements of thermal system?	2	L1	CO1	PO1
b.	Define Transfer function.	2	L1	CO2	PO1
c.	Name the different test signals.	2	L1	CO3	PO1
d.	Show the shape of polar plot for the transfer function, $G(S)H(S)=\frac{1}{1+T_1S}$, $G(S)H(S)=\frac{1}{S(1+T_1S)}$.	2	L2	CO4	PO1
e.	Define State variables.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Distinguish between open loop and closed loop systems with examples.	9	L2	CO1	PO1
b.	Derive the transfer function for an armature controlled D.C. motor.	9	L2	CO1	PO2
c.	Draw the functional diagram of a thermostat controlled home heating system and identify the components, input and output.	9	L2	CO1	PO2
	UNIT - II	**18**			
2 a.	Reduce the block diagram shown in Fig. 2(a) and determine the closed loop transfer function.  Fig. 2(a)	9	L3	CO2	PO2, 3

Contd... 2

b. Determine $\frac{C}{R}$ using Manson's gain formula for the system shown in Fig. 2(b)

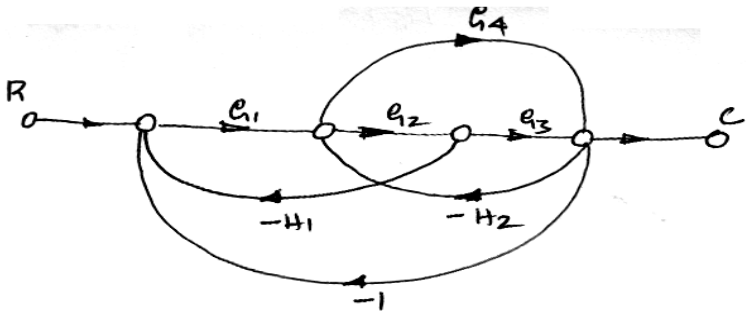


Fig. 2(b)

9 L3 CO3 PO2, 3

c. Prove that $\frac{C(S)}{R(S)} = \frac{G(S)}{1 \pm G(S)H(S)}$ for the closed loop system. 9 L3 CO3 PO2, 3

UNIT - III **18**

3 a. Drive the response of a second order critically damped system, subjected to unit step function input. Sketch the response of this system. 9 L2 CO3 PO2

b. For unit feedback system given, find rise time, peak time, maximum overshoot, settling time. When the system is subjected to step input of $G(S) = \frac{25}{S(S+5)}$. 9 L3 CO3 PO2

c. Explain Proportional-Integral-Differential controller by listing its characteristics. 9 L2 CO3 PO2

UNIT - IV **18**

4 a. Check the stability of the system using Routh's criteria, $S^3 + 6s^2 + 11s + 6 = 0$. 6 L3 CO4 PO2

b. A Negative feedback control system is characterized by $G(S)H(S) = \frac{5}{S(S+1)}$. Investigate the closed loop stability of the system using Nyquist stability criterion. 12 L4 CO4 PO3

c. The open loop transfer function control system is, $G(S) = \frac{10}{S(1+0.5S)(1+0.1S)}$. Draw the Bode plot and hence ascertain the system stability. 12 L4 CO4 PO3

Contd... 3

UNIT - V **18**

5 a.	A negative feedback control system is characterized by, $G(S)=\frac{K}{S(S+1)(S+2)(S+3)}$. Sketch the root locus plot for values of 'K' ranging from 0 to ∞ mark all the salient points on the root locus.	12	L4	CO5	PO3
b.	Obtain the state space equation of a system whose differential equation is, $\frac{d^3y}{dt^3}+6\frac{d^2y}{dt^2}+11\frac{dy}{dt}+6y=3u.$	12	L4	CO5	PO1
c.	Explain the following concepts with example: i) Controllability ii) Observability	6	L2	CO5	PO1

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