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

(An Autonomous Institution affiliated to VTU, Belagavi)

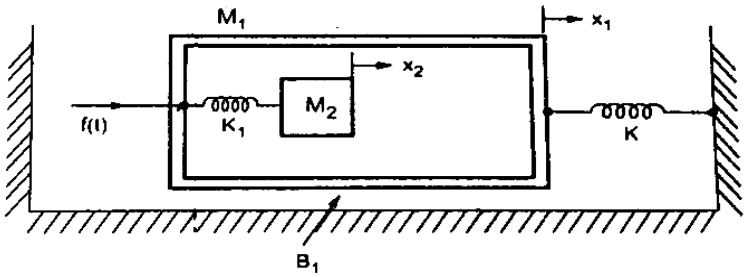
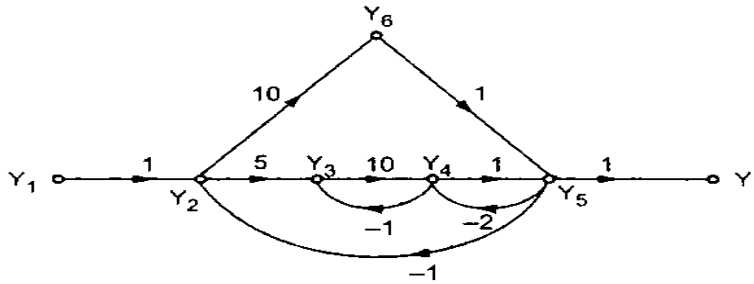
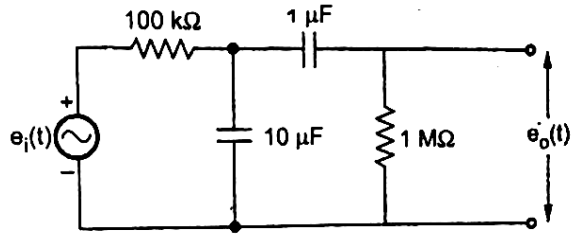
Fifth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; Feb. - 2021

Liner Control Systems

Time: 3 hrs *Max. Marks: 100*

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
	I : PART - A	**10**
I a.	Define control system. Give an example.	2
b.	Mention any two disadvantages of static error coefficient method for determining steady state errors.	2
c.	Define marginal value of K in Routh's stability analysis.	2
d.	What are Minimum and Non-minimum phase systems?	2
e.	State Nyquist stability criterion.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	i) Broadly classify the control systems.	5
	ii) Determine the transfer function $X_2(s) / F(s)$ for the mechanical system shown below, 	4
b.	i) Deduce the Transfer function model for Armature controlled DC Motor.	5
	ii) Using Mason's gain formula, find Y_5 / Y_1 for the signal flow graph shown below, 	4
c.	i) Distinguish between armature controlled and field controlled DC Motors.	5
	ii) Draw the Block diagram from the electric circuit shown below, 	4

Contd… 2

UNIT - II

18

2 a. i) Define the terms: Rise time, Peak time, Peak overshoot, Settling time and Delay time. 5

ii) A unity feedback system is given by $G(s) = \frac{20(s+2)}{s(s+3)(s+4)}$. Find static error constant. Also find steady state error for $r(t) = 5(t)u(t)$. 4

b. i) Obtain unit step response of a second order system for under damped case. 5

ii) A unity feedback system has an open loop transfer function $G(s) = \frac{5}{s(s+1)}$. Find the rise time, percentage overshoot, peak time and settling time for a step input of 10 units. 4

c. A unity feedback system is given by $G(s) = \frac{K(S+\alpha)}{(S+\beta)^2}$ is to be designed to meet the following specifications: Steady state error for a unit step input = 0.1; 9

Damping ratio = 0.5; Natural frequency = $\sqrt{10}$ rad/s. Find K, α and β.

UNIT - III

18

3 a. i) What are the necessary conditions for stability? Explain. 5

ii) A unity feedback control system has $G(s) = \frac{K(S+13)}{S(S+3)(S+7)}$. Using Routh's criterion, calculate the range of K for which the system is stable. 4

b. i) Explain the procedure to construct the Root locus. 5

ii) What are the effects of addition of open loop pole to $G(s)H(s)$? 4

c. Sketch the complete root locus of the system having $G(s)H(s) = \frac{K}{S(S+1)(S+2)(S+3)}$ .Comment on stability. 9

UNIT - IV

18

4 a. i) List out the advantages of frequency response analysis. 5

ii) Transient response of a second order under damped system subjected to unit step input is having 16.2% at time $\pi/5\sqrt{3}$. If the system is subjected to sinusoidal input, find the frequency of the input at which amplitude of steady state response will have maximum value and maximum value of steady state output. 4

b. i) Explain how G.M. and P.M. are determined from Bode Plot? 5

ii) Define the terms: 4

Gain margin, Phase margin, gain crossover frequency and phase crossover frequency.

c. Sketch the Bode diagram for the following transfer function and obtain the gain and phase crossover frequencies, $G(s) = \frac{10}{S(1+0.4s)(1+0.1s)}$. 9

UNIT - V

18

5 a. i) Define polar plot. What are its advantages? 6

ii) Draw the typical sketches of polar plot for the following systems: 6

Type 0, Order 1; Type 1, Order 2; Type 0, Order 3.

b. i) State and explain Mapping theorem. 6

ii) Explain Nyquist stability criterion. 6

c. For a feedback control system, $G(s)H(s) = \frac{40}{(S+4)(S^2+2S+2)}$. Find Gain Margin and Stability From Nyquist Plot. 6

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