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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2023 (2019 Scheme)

Course Code: MRT 303

Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer all questions; each question carries 3 marks) Marks

1 Why negative feedback is preferred in control systems? 3

2 For the electrical network shown in fig.1, determine the transfer function $\frac{E_0(s)}{E_i(s)}$ 3

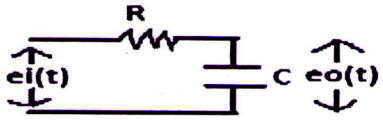


fig.1

3 Write the analogous electrical elements in force voltage analogy for the elements of mechanical translational system. 3

4 State the difference between Newtons second law and D'Alembert's principle. 3

5 Fill the table given below. 3

Name of the signal	Mathematical expression	Laplace transform
Step	----------	----------
Impulse	----------	----------
Sinusoidal	----------	----------

6 Define transient and steady state response of a control system. 3

7 What is the relationship between poles and system stability? 3

8 Classify the following transfer functions as minimum phase and non-minimum phase systems. Justify. 3

$$G1(S) = \frac{S+10}{S+5} \quad ; \quad G2(S) = \frac{S-10}{S+5}$$

9 What is Ziegler-Nichols tuning method ? 3

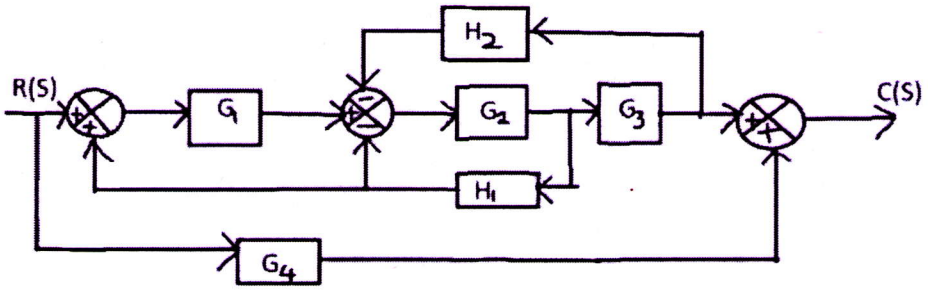
10 For which purpose Lag Compensator is used? 3

PART B

(Answer one full question from each module, each question carries 14 marks)

Module -1

11 a) Convert the block diagram into signal flow graph and determine the transfer function using Mason's gain formula. 14



12 a) Write any two rules of block diagram algebra. 2

b) Construct the block diagram of a series RLC circuit. 12

Module -2

13 a) Draw the force-current analogous circuit of a typical mechanical translational system. 5

b) Derive the transfer function of a field-controlled DC motor. 9

14 a) Write the differential equations governing the mechanical system shown in fig.2. Draw the torque-voltage and Torque-current electrical analogous circuits and verify by writing mesh and node equations. 14

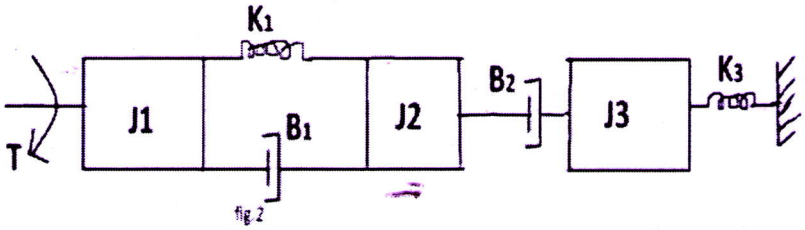


fig.2

Module -3

15 a) Derive and draw the time response of an underdamped second order control system for a unit step input. 10

b) List any four Time Domain Specifications. 4

16 a) Define static error constants. 3

b) For servomechanisms with open loop transfer function given below, explain what type of input signal give rise to a constant steady state error and calculate their 11

values.

i) $G(S) = \frac{20(S+2)}{S(S+1)(S+3)}$

ii) $G(S) = \frac{10}{(S+2)(S+3)}$

Module -4

17 a) The open loop transfer function of a unity feedback control system is given by $G(S) = \frac{1}{s^2(1+S)(1+2S)}$. Sketch the polar plot and determine the gain margin and phase margin. 14

18 a) Sketch the root locus for the unity feedback control system whose open loop transfer function is $G(S) = \frac{K(s^2+6s+5)}{s(1+S)(2+S)}$. 14

Module -5

19 a) Describe the working of an automatic temperature control system. 8

b) Compare lag and lead compensators. 6

20 a) Consider a unity feedback system with open loop transfer function $G(S) = \frac{5}{s(0.5+S)(1+S)}$. Design a PD controller so that the phase margin of the system is 30 degree at a frequency of 1.2 rad/sec. 14

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