Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (S,FE) Examinations June 2026 (2019 Scheme)

Course Code: MRT303
Course Name: LINEAR CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

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

1 Illustrate any three rules of block diagram algebra. 3

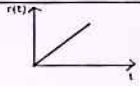
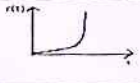
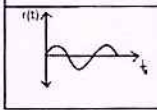
2 Define transfer function. How do you find transfer function of electrical systems? 3

3 Write the torque balance equation of idealized elements in a rotational mechanical system. 3

4 Tabulate the analogous electrical elements in force current analogy for the elements of mechanical translational system. 3

5 Define static error constants in a control system. 3

6 Fill the table given below. 3

Signal waveform	Name of the signal	Mathematical expression	Laplace transform
	----------	----------	----------
	----------	----------	----------
	----------	----------	----------

7 Name one graphical method used in stability analysis of a control system. Write the steps. 3

8 List any three frequency domain specifications with proper definition and mathematical expression. 3

9 Compare phase lead and phase lag compensators. 3

10 How does the derivative term affect PID controller performance? 3

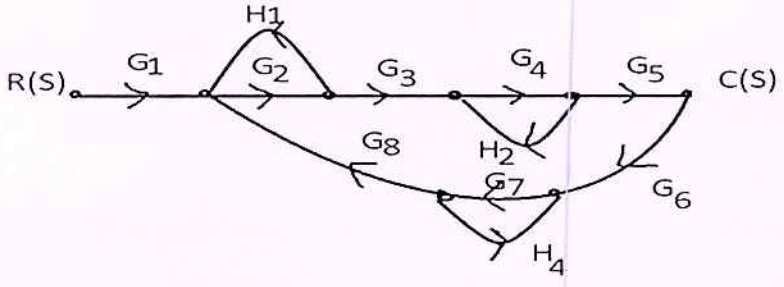
PART B

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

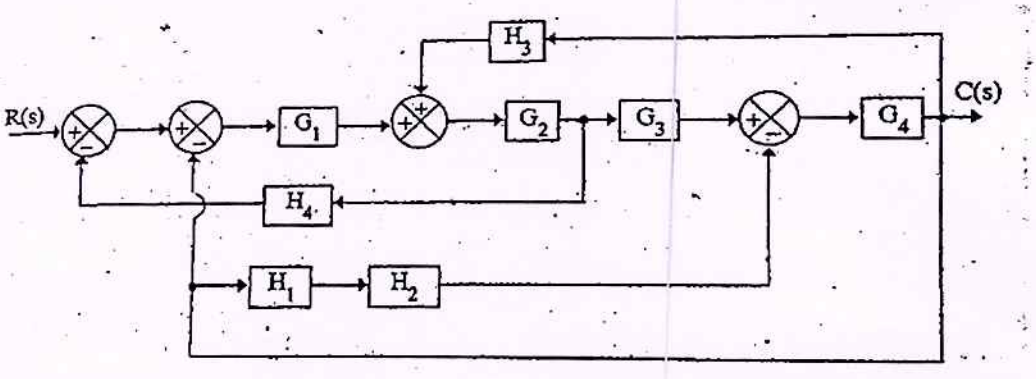
Module -1

11 a) Write any four properties of signal flow graph. 4

b) Apply Mason's Rule to calculate the transfer function of the system represented by the following signal flow graph. 10



12 a) Using block diagram reduction technique, find the transfer function C(S)/R(S) for the system shown in figure below. 10



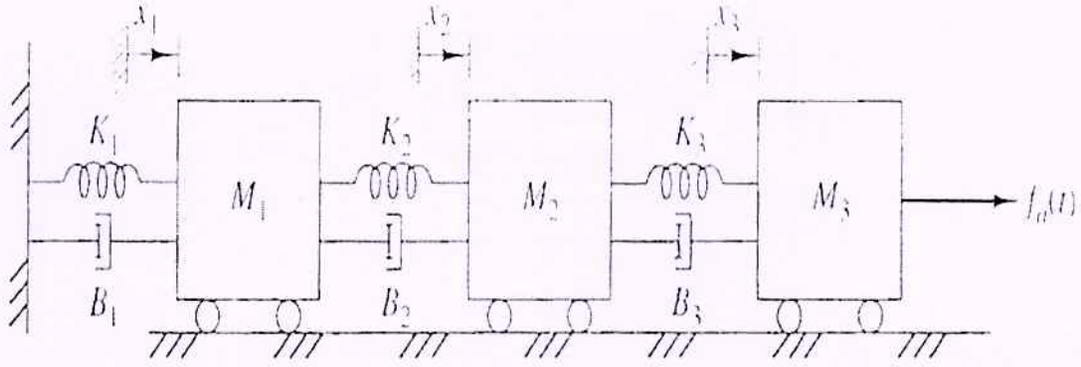
b) Differentiate open loop and closed loop control system. Give two examples for each. 4

Module -2

13 a) Obtain the Force-Voltage analogy of translational mechanical systems. 4

b) Derive the transfer function of armature-controlled DC motor with the help of schematic diagram. 10

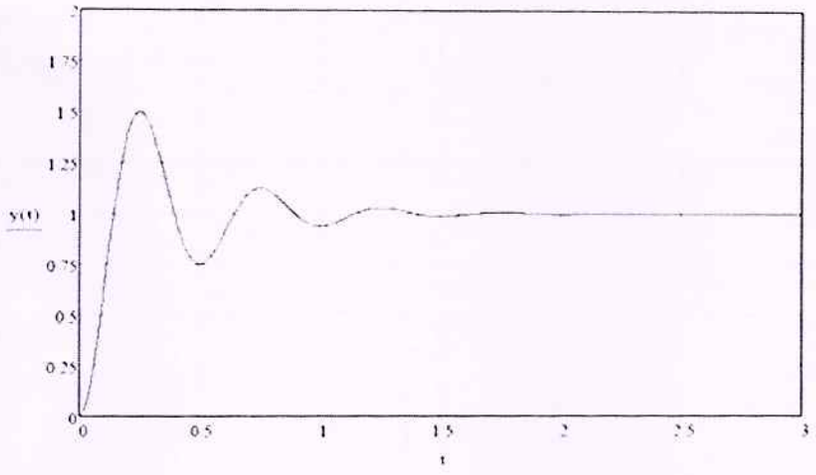
14 a) Draw the free-body diagram for each mass and write the differential equations describing the system. Draw the force-voltage and force-current electrical analogous circuits and verify by writing mesh and node equations. 12



b) What is meant by mathematical modelling? 2

Module -3

15 a) Identify the time response given below. Label any 3 time domain specification in it and explain them with proper definition and mathematical expression. 7



b) A unity feedback system has the forward transfer function G(s)=K1(1+2s)/ s(5s+1)(1+s)^2. The input r(t)=1+6t is applied to the system. Determine the minimum value of K if the steady state error is to be less than 0.1 7

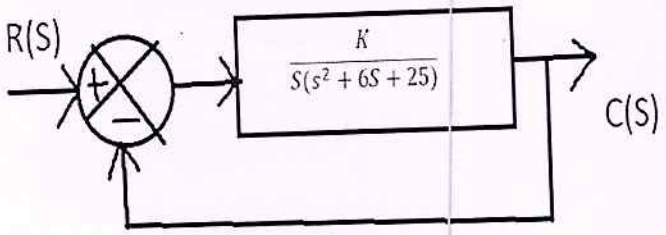
16 a) What will be the response of a first order system with unit step input? 9

b) The closed loop transfer function of second order system is 5

C(S)/R(S) =$10/s^2 + 6s + 10$. What is the type of damping in the system?

Module -4

17 a) Sketch the root locus of the control system shown in figure. Find the limiting value of K for the stability of the system. 14



18 a) For the function G(S)H(S)=$\frac{5(1+2s)}{(1+4s)((1+0.25s)}$,draw the logarithmic plot. 14

Module -5

19 a) Find the phase shift provided by the phase lead compensator with transfer function given by 5

$$G_C(S) = \frac{(1+6S)}{(1+2s)}$$

b) What are the elements of an industrial automatic controller? Classify feedback controllers on the basis of control action and explain in detail. 9

20 a) Consider a unity feedback system with open loop transfer function

$G(S) = \frac{100}{(s+1)(s+2)(s+3)}$. Design a PI controller so that the phase margin of the system is 60 degree at a frequency of 0.5 rad/sec.

***