Reg No.:_____ Name:_____

1100MRT303122301

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree (S, FE) Examination June 2024 (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

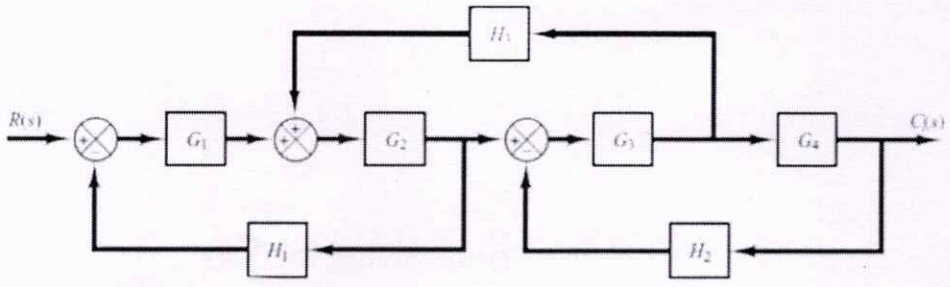
1	Distinguish between open loop and closed loop system.	3
2	Write the block diagram reduction algebra for the following cases i) Moving a summing point before a block ii) Moving a take of point after a block iii) Elimination of positive feedback	3
3	Explain the analogous electrical elements in force-voltage analogy for the elements of mechanical translational system.	3
4	Write the torque balance equation of the idealized elements in a rotational mechanical system.	3
5	Determine the damping ratio and natural frequency of oscillation of the system whose closed loop transfer function is given by $200 / s^2 + 20s + 200$	3
6	A unity feedback system has an open loop transfer function of $G(s) = \frac{10}{(s+1)(s+2)}$ Determine the steady state error for unit step input.	3
7	How the roots of characteristics equation are related to stability.	3
8	List any three advantages of frequency response analysis.	3
9	Which compensator behaves as a high pass filter? Write the transfer function and draw its pole-zero plot.	3
10	Explain lag compensator with an example.	3

PART B

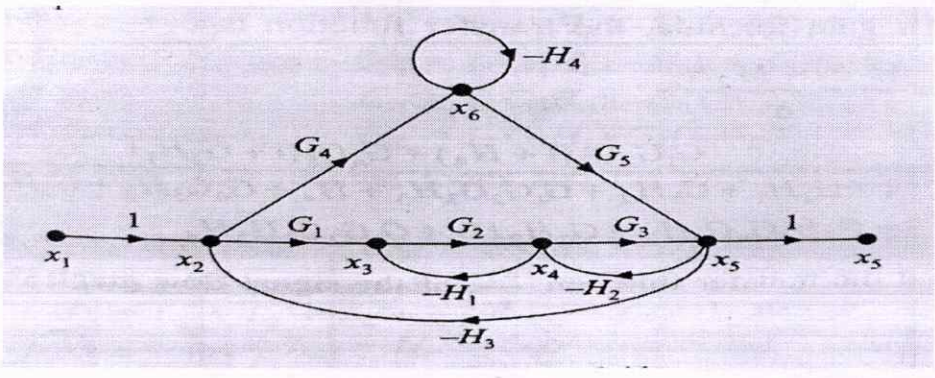
(Answer one full question from each module, each question carries 14 marks)

Module -1

11	Simplify the block diagram shown in figure then obtain the closed loop transfer function $C(S)/R(S)$	14

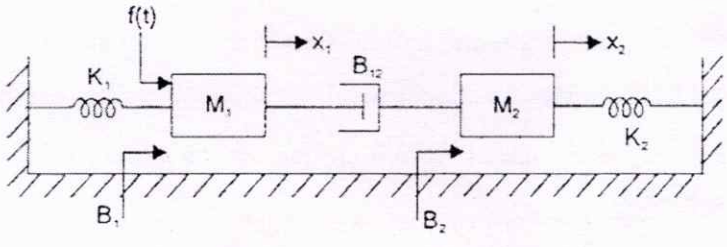


12 Apply the gain formula to the signal flow graph shown in figure to find the transfer function X_5/X_1 14



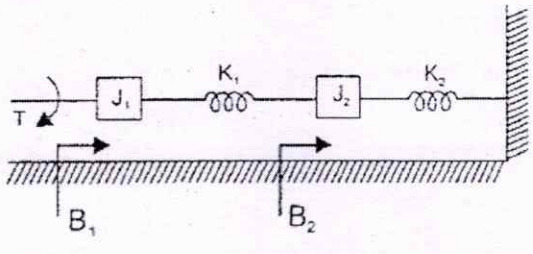
Module -2

13 Determine the transfer function of the given mechanical system 14



14 a) Derive the transfer function of an armature-controlled DC motor. 7

b) Draw the torque-voltage and torque–current electrical analogous circuits and verify by writing mesh and node equations of the given system. 7



Module -3

15 a) Consider a unity feedback system with a closed loop transfer function $\frac{C(S)}{R(S)} = \frac{KS+}{S^2+aS+}$. 10

i)Determine the open loop transfer function G(S).

ii) Show that the steady state error with unit-ramp input is given by $\frac{a-K}{b}$.

b) Label the following time domain specifications on step response of under damped second order control system and also write their definition. 4

i) Delay time

ii) Peak overshoot

16 A unity feedback system has $G(S) = \frac{K}{S(S+1)(0.1S+1)}$ and r(t) =10t.

a) If K=2, determine $E_{ss}(t)$. 8

b) Find the minimum value of K for $E_{ss}(t)$ <0.1 for a unit ramp input 6

Module -4

17 For the given transfer function, draw bode plot and obtain gain cross over frequency. 14

$G(s) = \frac{20}{s(1+3s)(1+4s)}$

18 A unity feedback control system has an open loop transfer function $G(S) = \frac{K(S+2)}{S(S+3)}$ Sketch the root locus. 14

Module -5

19 a) Realize a lag compensator using electrical network and draw the bode diagram. 12

b) What are the applications of PID controller? 2

20 a) Explain automatic traffic light control with necessary sketches 8

b) Compare PI and PD controllers. 6

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