Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S6 (PT) (S,FE) Examination May 2024 (2015 Scheme)

Course Code: EE304

Course Name: ADVANCED CONTROL THEORY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries5 marks.

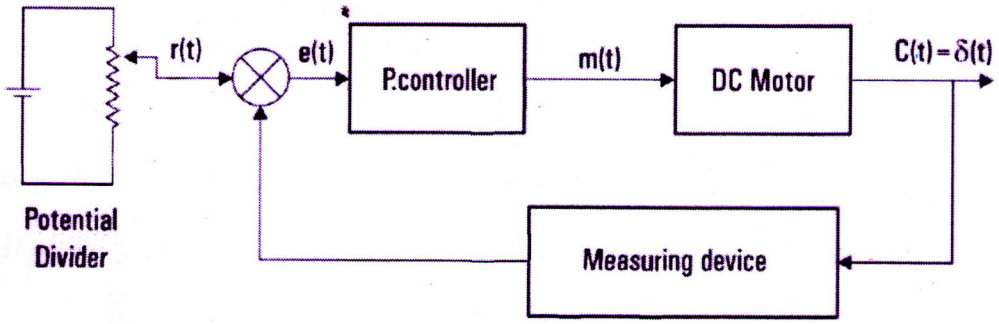
		Marks
1	Consider a unity feedback system with open loop transfer function $G(s) = \frac{K}{s(s+3)(s+5)}$. What is the effect of K on gain cross over frequency and phase margin.	(5)
2	Explain a suitable method to design a PID controller when analytical models are not available. List its limitation.	(5)
3	List any four advantages of state space approach.	(5)
4	Consider the system with characteristic polynomial $F(Z)=2z^4 - 7z^3 - 10z^2+4z+1$ Investigate the stability of the system using Jury's Test.	(5)
5	What are the limitations of describing function method	(5)
6	With the help of figure discuss any three characteristics of nonlinear systems	(5)
7	Write short notes on phase plane method	(5)
8	Explain the concept of stability in the sense of Liapunov.	(5)

PART B

Answer any two full questions, each carries10 marks.

9		Write the transfer function of a typical lag-lead compensator. Sketch its Bode plot and mark all the corner frequencies	(10)
10		The open loop transfer function of a unity feedback system is $G(S) = \frac{2}{s(1+0.5s)}$. Design a lead compensator such that the compensated system has a phase margin of 50°, gain margin is at-least 10dB and steady state error to a ramp input is equal to 0.05.	(10)
11	a)	Consider the position control system given below. The objective of the control system to is to track the angular displacement of the dc motor δ. Assume DC motor is represented by type one second order system and measuring device is represented .	(5)

by unity gain. What will be the effect of gain of the Proportional controller on steady state error to a ramp input and maximum overshoot. Explain your answer.



b) Consider a unity feedback system with open loop transfer function G(s) = K/s(s+4). (5)
Find closed loop poles and damping ratio when K=2 and K=10.
What is the effect of K on damping ratio?
What is the effect of K on velocity error coefficient.

PART C

Answer any two full questions, each carries10 marks.

12 a) What are the properties of state transition matrix? (5)

b) Consider the system (5)

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X$$

Obtain the state transition matrix using Cayley-Hamilton Theorem.

13 a) Given (5)

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \quad y = [1 \quad 0]X$$

Derive the transfer function.

b) Obtain the pulse transfer function of the system described by the difference equation (5)

$$c(k) - 0.1c(k-1) = r(k)$$

14 a) Consider the system (3)

$$\dot{x} = \begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u; \quad y = [1 \quad 0]X$$

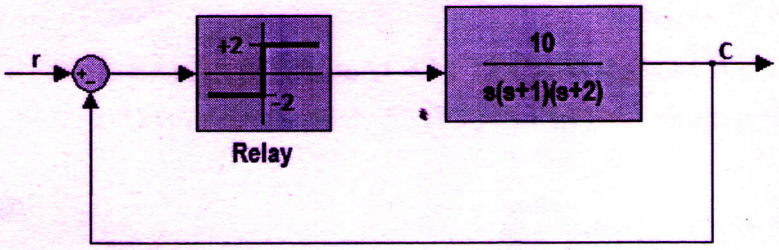
Find the Eigen values of the system matrix. Is the system stable?

b) Design a state feedback controller so that the closed loop poles are at -5 and -6 (7)

PART D

Answer any two full questions, each carries 10 marks.

15 a) The block diagram of the system with relay nonlinearity is shown in Fig. (10)
Investigate the stability of the system by describing function method.



16 a) With the help of figures, explain 4 different types of singular points (4)

b) With the help of input output characteristics, explain 3 different non-lineairities (6)

17 a) Investigate the stability of the system given below using Liapunov's Direct method (10)

$$\dot{X} = \begin{bmatrix} -1 & -2 \\ 1 & -4 \end{bmatrix} X$$

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