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Reg No.:_____   Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
Fifth Semester B.Tech Degree (R, S) Examination November 2024 (2019 Scheme)

Course Code: RAT 307

Course Name: CONTROL SYSTEMS

(Provide normal graph sheets and semi-log graph sheets)

Max. Marks: 100   Duration: 3 Hours

PART A

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

|		
1	List the basic elements of translational mechanical systems and their force equations.	3
2	Define Mason's gain formula. What is it used for?	3
3	What are dynamic error coefficients?	3
4	Define absolute stability, conditional stability, marginal stability.	3
5	Compare lag compensator with lead compensator.	3
6	Define Gain margin and Phase Margin.	3
7	When is a system said to be observable?	3
8	Define state, state variable, state vector.	3
9	List the classification of singular points.	3
10	List any 3 characteristics of non-linear systems.	3

PART B

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

Module -1

11	a)	Draw the block diagrams and derive transfer functions of an open loop control system and closed loop control system	9
	b)	Explain the following term related to robotics: Encoders	5

12   Using block diagram reduction method, find closed loop transfer function   14
of the system whose block diagram is as shown below:
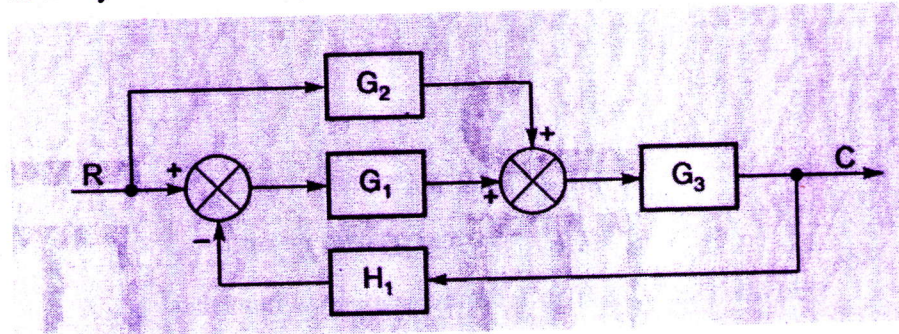
Module -2

13   a)   Derive the expression for position error constant, velocity error constant,   6
and acceleration error constant.

     b)   Find the steady state error for Type 0, Type 1 and Type 2 systems.   8

14   Determine the response of an underdamped second-order system for a unit   14
step input.

Module -3

15   A unity feedback system has an open loop transfer function   14

$$\frac{K}{S(S+1)(S+2)}$$

Sketch the root locus.

16   For the OLTF given below (i) Construct the bode plot. (ii) Obtain the gain   14
margin and phase margin.

$$\frac{1}{S(S+2)(S+4)}$$

Module -4

17   Obtain the state model of the system whose transfer function is given by   14

$$\frac{Y(s)}{U(s)} = \frac{S^2+7S+2}{S^3+9S^2+26S+24}$$

18 a) Find the Transfer function of the state variable description of a system given by the matrix equation, **8**

$$X' = \begin{bmatrix} -1 & 0 \\ 1 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} U$$

$$Y = [1 \ 1] X$$

b) Use Kalman method to find the controllability of the given system. **6**

$$\begin{bmatrix} \dot{X1} \\ \dot{X2} \\ \dot{X3} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} X1 \\ X2 \\ X3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U$$

Module -5

19 With examples, explain the different types of non-linearities. **14**

20 With the help of diagrams, illustrate the classification of singular points. **14**

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