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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2022 (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 Draw the Block Diagram of an open loop and closed loop control system 3

2 Can Mason's gain formula be used to develop the transfer function of the system? Justify 3

3 The closed loop transfer function of a second order system is given by 3

$$\frac{20}{S^2 + 10S + 20}$$

Determine the damping ratio and the natural frequency of oscillations.

4 The characteristic equation of two systems is given below, Identify the stable system 3

$$G1(s) = s^3 + 2s^2 + 3s + 1$$

$$G2(s) = s^3 + 2s^2 + s + 3$$

5 Explain the effect of adding a pole to the open loop transfer function of a system. 3

6 Define gain cross over frequency and phase cross over frequency of a system. 3

7 Give the block diagram of the linear continuous time control system represented in state space 3

8 Define the following 3
a. state variable b. state space c. state vector

9 Explain the characteristics of nonlinear systems . 3

10 Explain Describing function analysis of non linear systems 3

PART B

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

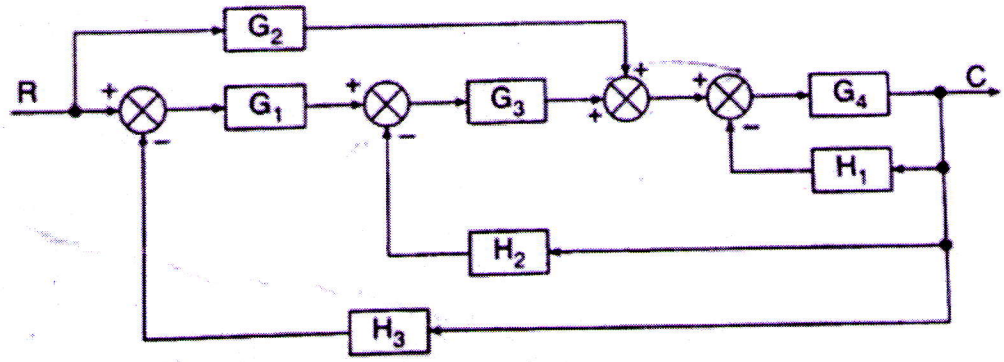
Module -1

11 a) Derive the transfer functions of an armature-controlled DC motor. 8

b) Differentiate between Force voltage and Force current analogy. 6

OR

12 Obtain C(s)/ R(s) for the system whose block diagram is shown below 14



Module -2

13 Find response of the unity feedback system with open loop transfer function mentioned below for Unit step Input and comment on its stability based on the location of poles 14

$$G(s) = \frac{1}{(S^2 + s)}$$

OR

14 Conduct the steady state error Analysis for the following reference input to a closed loop system 14

i) Unit Step

ii) Unit Ramp

iii) Unit Parabolic

And also obtain static error coefficients for each input for Type 0,1,2 systems

Module -3

15 Plot the root locus of the unity negative feedback system with forward path transfer function $\frac{K}{(S+4)(s-1)}$. 14

OR

16 Sketch Bode plot for the following transfer function $G(s) = \frac{(s+3)}{s(s+1)(s+2)}$ and find the phase margin and gain margin 14

Module -4

17 a) Explain Controllability and Observability 8

b) Find the state space model for the system having transfer function. $\frac{C(s)}{R(s)} = \frac{1}{s^2+s+1}$ 6

OR

18 a) Find the solution of homogeneous equation for the following state equation 8
$\dot{x} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} x$, when $x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$

b) Derive the transfer function from the state model 6

Module -5

19 With the help of suitable diagram explain the common physical non linearities 14

OR

20 Derive the describing function of an ideal relay non linearity 14

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