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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: RAT307
Course Name: CONTROL SYSTEMS

Max. Marks: 100 Duration: 3 Hours

PART A

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

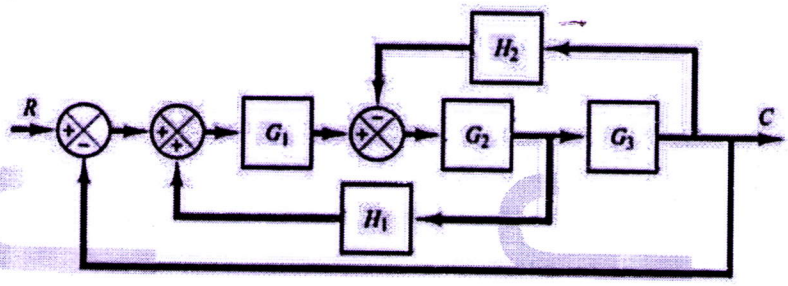
1	List the main components of a typical control system.	3
2	Differentiate between DC and AC servo motors in terms of control.	3
3	Define various static error constants related to a closed loop system.	3
4	Compare and contrast type and order of a system	3
5	We are not using Integral control alone for a controller design. Comment on it.	3
6	Define gain crossover frequency and phase crossover frequency.	3
7	Discuss the properties of State transition matrix.	3
8	Draw the state diagram of the state space representation of a system	3
9	Define asymptotic stability. Distinguish between stability in large and stability in small	3
10	State and Explain concept of stability in the sense of Lyapunov.	3

PART B

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

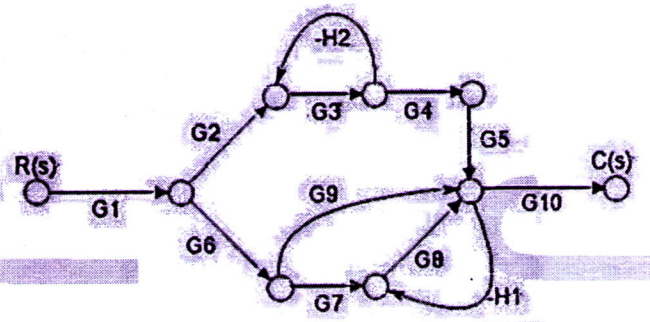
Module -1

11 a) Find the transfer function of the given system using block diagram reduction method. 9



b) Write note on linear and rotary encoders 5

12 a) Using Mason's gain formula find the transfer function of the system shown in figure below. 9



b) Illustrate the importance of Control system in Robotics. 5

Module -2

13 a) Determine the range of K for stability of unity feedback system whose open loop transfer function is $G(s) = \frac{K}{s(s+1)(s+2)}$ 9

b) Define Transfer function of a system. Establish the relationship between impulse response and transfer function of a system 5

14 a) A unity feedback system has the forward transfer function $G(s) = \frac{K(2s+1)}{s(5s+1)(1+s)^2}$. When the input is $r(t) = 1 + 6t$, determine the minimum value of K so that steady state error is less than 0.1. 9

b) Sketch the response of a second order underdamped system. Also define and mark various time domain specifications. 5

Module -3

15 a) The open loop transfer function of a unity feedback system is given by $G(s) = \frac{K}{s((s+2)(s+4)}$. Sketch the rootlocus of the system. 10

b) Differentiate between phase margin and gain margin. 4

16 a) Sketch the Bode plot for the following transfer function and determine the system gain K for the gain cross over frequency to be 5 rad/sec. 10

$$G(s) = \frac{Ks^2}{(1 + 0.2s)(1 + 0.02s)}$$

b) The characteristic equation of a system is given by 4

$$s^3 + 3s^2 + 9s + K = 0$$

Find the values of K for the system to be stable.

Module -4

17 a) Compute the state transition matrix for a system represented by the state equation $\dot{X}(t) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X(t)$ by Laplace transform method. Also compute the solution of the homogeneous equation, assuming the initial state vector , $X(0) =$ 10

$\begin{bmatrix}1\\0\end{bmatrix}$

b) Derive the equation for solution of homogenous state equation. 4

18 a) State equation of a MIMO system is given by 10

$\dot{X} = AX + Bu$ and $y = CX$

Where

$A = \begin{bmatrix}-1 & -1 & 0\\ 0 & 0 & 1\\ 0 & -3 & -4\end{bmatrix}$ $B = \begin{bmatrix}1 & 0\\ 0 & 1\\ 1 & 2\end{bmatrix}$ and $C = \begin{bmatrix}1 & 3 & 1\\ 1 & 2 & 0\end{bmatrix}$

Check whether the system is completely observable.

b) Define complete observability of a system. Explain the condition for complete observability in Kalman's method. 4

Module -5

19 a) Derive the describing function of a saturation non linearity. 10

b) Explain Sign definiteness in the sense of Lyapnov. 4

20 a) For the given system , find the eigen values using Jacobian matrix and also determine the type of singular points 10

$\ddot{x} + 0.5\,\dot{x} + 2x + x^2 = 0$

b) Derive describing function of ON/OFF relay 4

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