Reg No.:_____ Name:_____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Supplementary Examination August 2021

Course Code: EC409
Course Name: CONTROL SYSTEMS

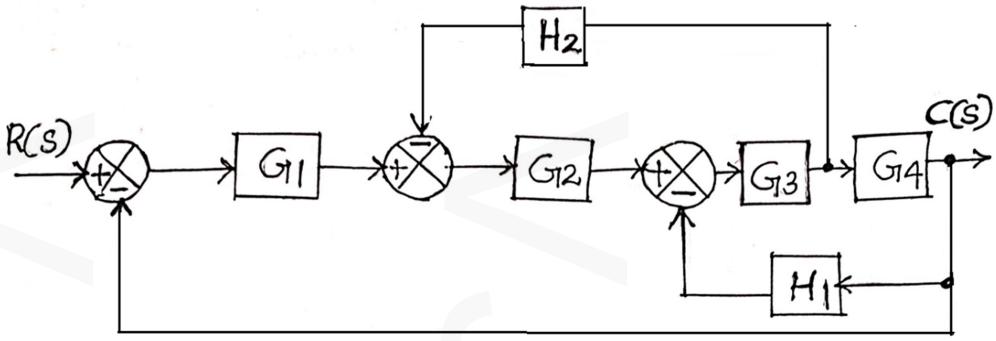
Max. Marks: 100 Duration: 3 Hours

(Graph sheet and semi- log sheets shall be provided)

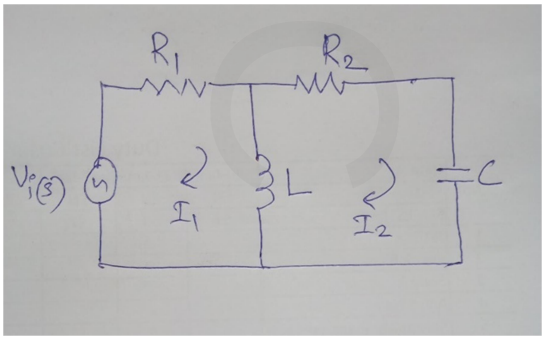
PART A

Answer any two full questions, each carries 15 marks

1. a) Determine the overall transfer function C(s)/R(s) for the system using block reduction technique. (8)



b) Find the transfer function $I_2(s)/V_i(s)$ the electrical system shown below (7)



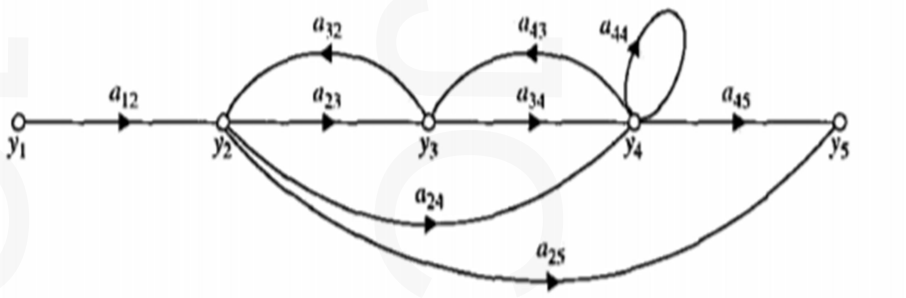
2. a) What are the four types of system based on the value of damping? (10)

Derive an expression for time response of second order under damped system to step input.

b) For an open loop transfer function with unity feedback

$G(s) = \frac{k(s+5)}{s(s+6)(s+7)(s+9)}$, Find the value of k so that there is 5% error in the steady state. (5)

3. a) Determine the overall transfer function $Y_5(s)/Y_1(s)$ for the signal flow graph using Masons gain formula (7)



b) Explain time domain specifications with neat sketch. (5)

c) The open loop transfer function of a system with unity feedback is given by G(s)= $\frac{10}{s\,(s+2)}$. Find natural frequency and damping ratio (3)

PART B

Answer any two full questions, each carries 15 marks.

4. a) The characteristic equation is $S^4+S^3+5S^2+4S+4=0$. Using R H criteria, determine the stability of the system and comment on location of roots in s plane (5)

b) Sketch the root locus for $G(s) = \frac{k}{(s+1)(s^2+2s+2)}$ and comment on the stability of the system (10)

5. a) Sketch the bode plot for $G(s) = \frac{100\ (1+0.1s)}{s(1+0.2s)(1+0.3s)}$. Find gain margin and phase margin and hence comment on the stability of the system. (12)

b) What are P, PI, PID Controllers? (3)

6. a) Construct the Nyquist plot for a system whose open loop transfer function is $G(s)H(s) = \frac{K}{s(s+2)(s+10)}$.Determine the range of K for which closed loop system is stable (6)

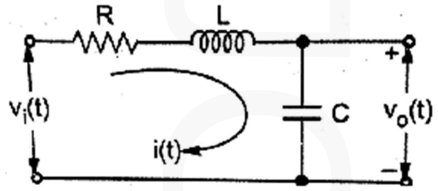
b) Explain Nyquist stability criteria. (4)

c) Explain the effect of adding poles and zeros in stability of system with the aid of root locus technique (5)

PART C

Answer any two full questions, each carries 20 marks

7. a)Obtain the state model of given electrical network (6)



b) List out the properties of state transition matrix. Determine state transition matrix for A=$\begin{bmatrix}1 & 2\\ 0 & 1\end{bmatrix}$ (6)

c) Check for stability of sampled data control system represented by

$Z^3 - 0.2Z^2 - 0.25Z + 0.02 = 0$. Use Jury's test (8)

8. a) Consider a system with state space model is

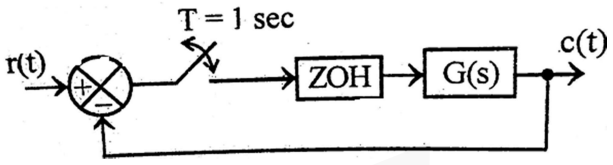
$x = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -2 & -3\end{bmatrix}X + \begin{bmatrix}0\\ 5\\ 1\end{bmatrix}U \;;\; y = [1 \quad 3 \quad 4]X + [0]U$ Check whether the system is controllable and observable. (10)

b) List out the advantages of using state space approach. (5)

c) What is pulse transfer function? What is the equivalent representation of pulse sampler with ZOH? (5)

9. a)For a sampled data control system, find the response to unit step input where (10)

$G(s) = \dfrac{1}{s+2}$



b) Obtain state model in phase variable form whose transfer function is given by

$\dfrac{C(s)}{R(s)} = \dfrac{2s^2+3s+5}{s^3+2s^2+11s+2}$ (10)

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