Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Supplementary Examination June 2022 (2015 Scheme)

Course Code: EC409

Course Name: CONTROL SYSTEMS

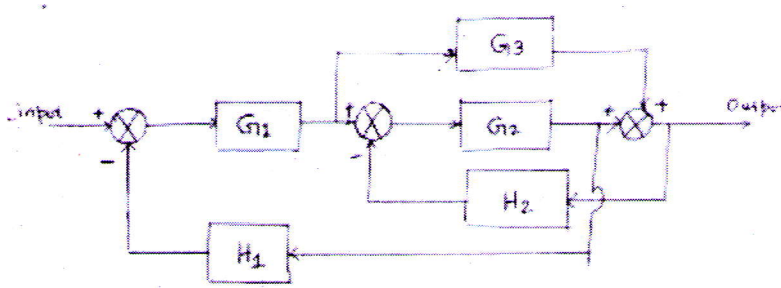
Max. Marks: 100 Duration: 3 Hours

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

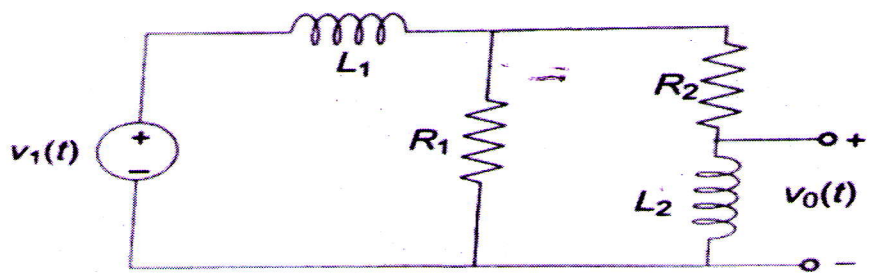
PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Determine the overall transfer function for a system represented by the block diagram shown below using block reduction technique. (7)



b) Find the transfer function $\frac{V_0(s)}{V_1(s)}$ of the electrical system shown below. (8)

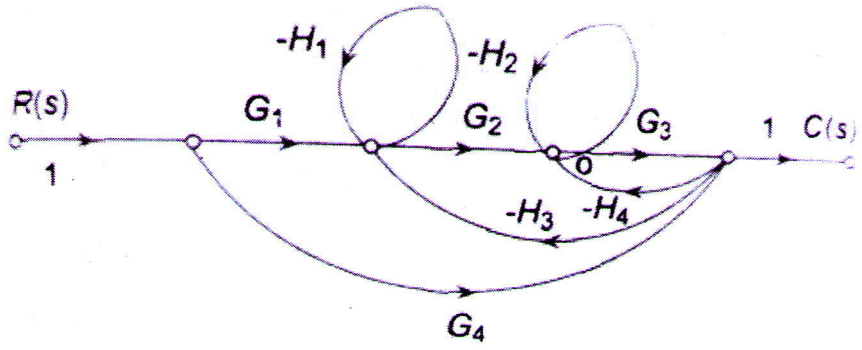


2 a) A second order system is described by the transfer function $\frac{C(s)}{R(s)} = \frac{144}{s^2+9.6s+144}$. Find the frequencies of undamped oscillation and damped oscillation, rise time, peak time, maximum overshoot (in %) and settling time for 2 % tolerance. (6)

b) A unity feedback control system has a closed loop system transfer function $\frac{C(s)}{R(s)} = \frac{as+K}{s^2+bs+K}$. Show that the steady state error is zero for unit ramp input if a=b. (5)

c) What is the difference between static and dynamic error coefficients (4)

3 a) From the signal flow graph shown find the transfer function using Maison's gain rule. (9)



b) Derive an expression for peak time and rise time for a second order system subjected to unit step input, (6)

PART B

Answer any two full questions, each carries 15 marks.

4 a) The characteristic equation of a feedback control system is given by $s^5 + 2s^4 + 3s^3 + 9s^2 + 2s + 10 = 0$. Find out the number of roots on the RHP, LHP and on the jω axis of s-plane. (6)

b) Construct the root locus for a feedback control system with open loop trsnfer function, $G(s)H(s) = \frac{K}{s(s^2+6s+10)}$. Find out the value of K at which the system becomes oscillatory. (9)

5 For unity feedback system the open loop transfer function is given by $G(s) = \frac{0.25(1+0.5s)}{s(1+2s)(1+4s)}$. Draw the Bode plot and thereby determine (15)

(i) Gain cross over frequency

(ii) Phase cross over frequency

(iii) Gain margin

(iv) Phase margin

(v) Assess the stability of the system

6 a) Compare P PI PID controllers (3)

b) Describe the design procedure of a lag compensator (5)

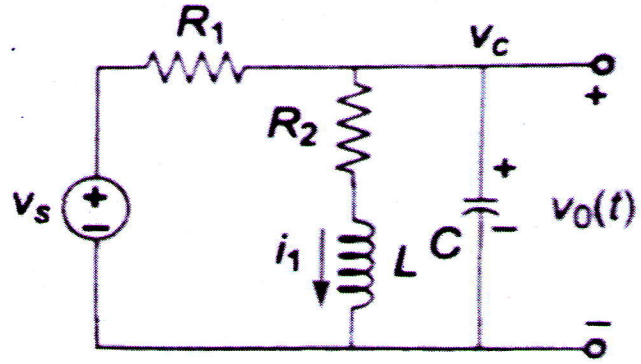
c) The open loop transfer function of a unity feedback system is given by (7)

G(s) = $\frac{60}{(s+a)(s+b)}$. If the peak resonance of a closed loop response is 0.6073 and the resonant frequency is 3.94 rad/s. find the values of a and b.

PART C

Answer any two full questions, each carries 20 marks.

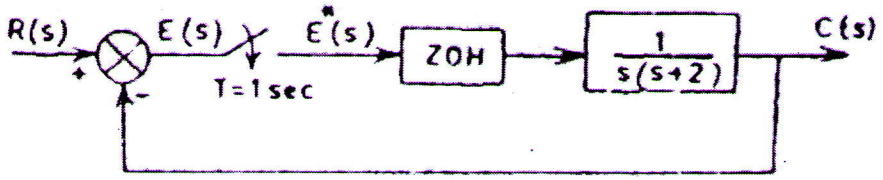
7 a) Obtain a state model for the circuit shown below. (8)



b) The system matrix of a LTI system is given by A=$\begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix}$. Obtain the state transition matrix. (7)

c) What are the advantages of using state space approach. (5)

8 a) Determine the pulse transfer function for the system shown (10)



b) Obtain state model of a system whose transfer function is given by (10)

$\frac{Y(s)}{R(s)} = \frac{3s^2+s+2}{s^3+7s^2+14s+8}$.

Obtain the state model in:

i) Controllable canonical form

ii) Observable canonical form

9 a) Use Jury's test to Check for stability of sampled data control system represented by (10)

$$z^4 - 1.2z^3 + 0.2z^2 + 0.05z - 0.001 = 0$$

b) A system is characterized by the transfer function $\frac{Y(s)}{U(s)} = \frac{2}{s^3+6s^2+11s+6}$. Check (10)

controllability and observability of the system using Kalman's test.

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