Reg No.:_____ Name:_____

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Regular and Supplementary Examination December 2021 (2015 Scheme)

Course Code: EC409

Course Name: CONTROL SYSTEMS

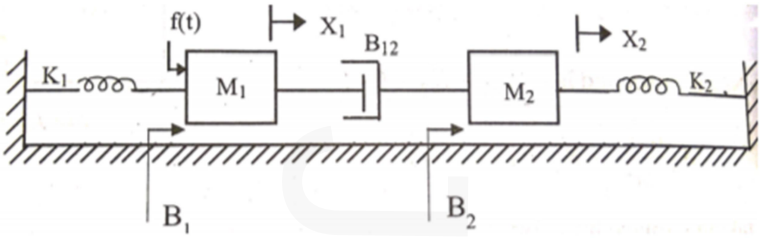
Max. Marks: 100 Duration: 3 Hours

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

PART A

Answer any two full questions, each carries 15 marks

1. a) Determine the transfer function of the system $X_2(s)/F(s)$ (6)



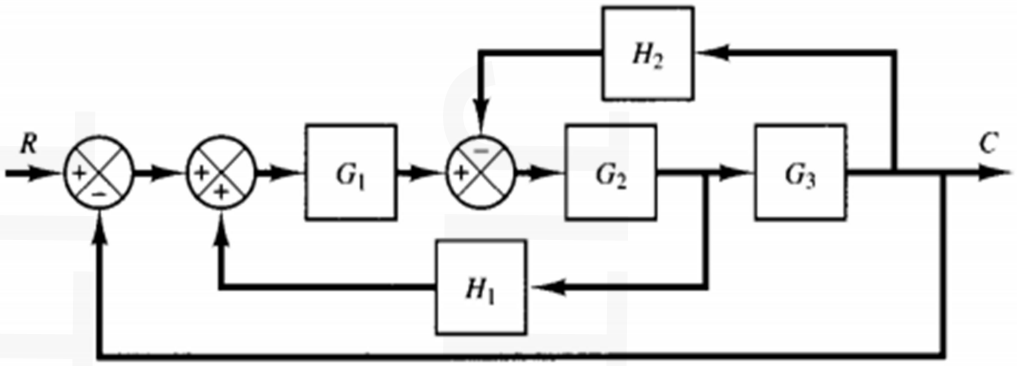
b) Draw the signal flow graph for the following set of algebraic equations (9)

$x_2=x_1+ax_5$, $x_3=bx_2+cx_4$,$x_4=dx_2+ex_3$,$x_5=fx_4+gx_3$, $x_6=x_5$. Hence find the overall transfer function using Masons gain formula

2. a) Open loop transfer function of a unity feedback system is $G(s) = \frac{10}{s(s+5)(s+10)}$. Determine the steady state error and error constants for the input $r(t)= 5 + 10t + 6t^2$ (8)

b) Derive an expression for time response of a critically damped second order system to impulse input (7)

3. a)Reduce the block diagram using block reduction technique and find C(s)/R(s) (8)



b) Explain various time domain specifications with neat sketch and mention the corresponding equations also. (7)

PART B

Answer any two full questions, each carries 15 marks.

4. a) Draw the bode plot for $G(s)H(s) = \frac{10(s+100)}{s(s+5)(s+2)}$ Find gain margin and phase margin and hence comment on the stability of the system. (12)

b) Find damping ratio and natural frequency of oscillation of a second order system whose closed loop transfer function is given by $\frac{C(s)}{R(s)} = \frac{9}{s^2+6s+9}$. (3)

5. a) Construct Routh array and determine the stability of the system represented by the characteristic equation $S^6+2S^5+S^4+2S^3+S^2+2s+1=0$.Comment on the location of roots in s plane (8)

b) Describe the design procedure of lead compensator (7)

6. a) Sketch the root locus whose open loop transfer function is (12)

$G(s) = \frac{K}{s(s+1.5)(s+4)}$ and comment on the stability of the system.

b) Explain frequency domain specification with the help of bode plot and state the condition for stability. (3)

PART C

Answer any two full questions, each carries 20 marks

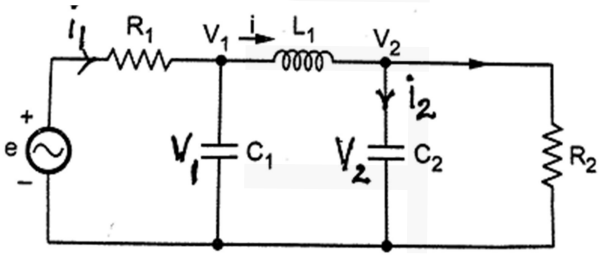
7. a) Consider the system with state equation

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} U \ .$$

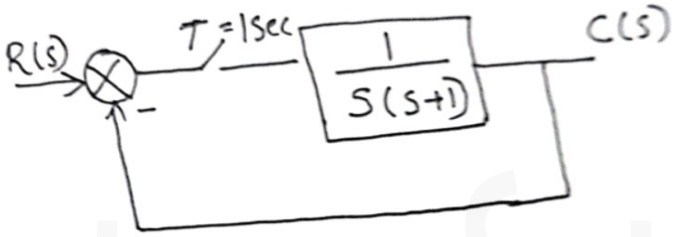
Estimate state controllability by Gilbert Test (8)

b) What are the properties of state transition matrix . Find the time response of a system whose A= $\begin{matrix} 1 & -1 \\ 0 & -2 \end{matrix}$ and X(0) = $\begin{matrix} 0 \\ 1 \end{matrix}$ (7)

c) Obtain the state model of given electrical system (5)



8. a) Find the pulse transfer function for the error sampled system shown in figure.



(10)

b) Solve the difference equation c(k+2)+3c(k+1)+2c(k)=u(k),where c(0)=1; c(1)= -3; c(k)=0 for k<0.Determine Z transform (10)

9. a) Obtain the state equation and output equation in phase variable form

$$\frac{Y(s)}{U(s)} = \frac{6s^2+12s+}{s^3+6s^2+10s+}$$ (10)

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

F (z) =Z^4-1.8Z^3+1.09Z^2-0.26Z+0.025=0. Use Jury's test

(10)
