Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: EC409

Course Name: CONTROL SYSTEMS

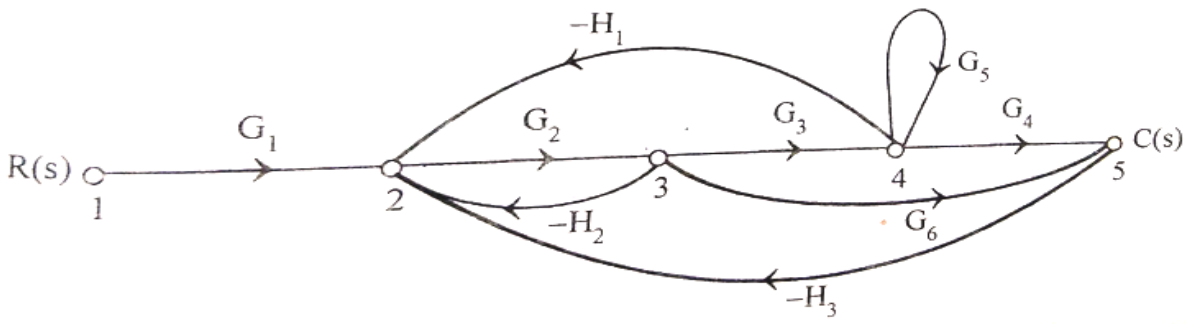
Max. Marks: 100 Duration: 3 Hours

Note: Provide normal and semi log graph sheet

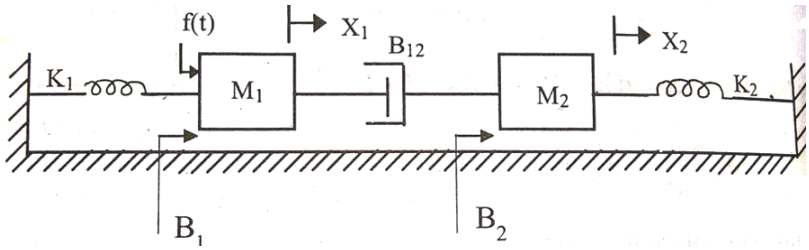
PART A

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

1 a) Find the overall gain C(s)/R(s) for the signal flow graph shown using Mason's gain equation. (8)



b) Determine the transfer function $X_1(s)/ F(s)$ for the system shown below. (7)



2 a) The open loop transfer function of a servo system with unity feedback is (7)

$G(s) = \frac{10}{s(0.1s+1)}$. Evaluate the static error constants of the system. Obtain the steady state error of the system when subjected to an input given by

$r(t)= a_0 +a_1t+a_2t^2/2$.

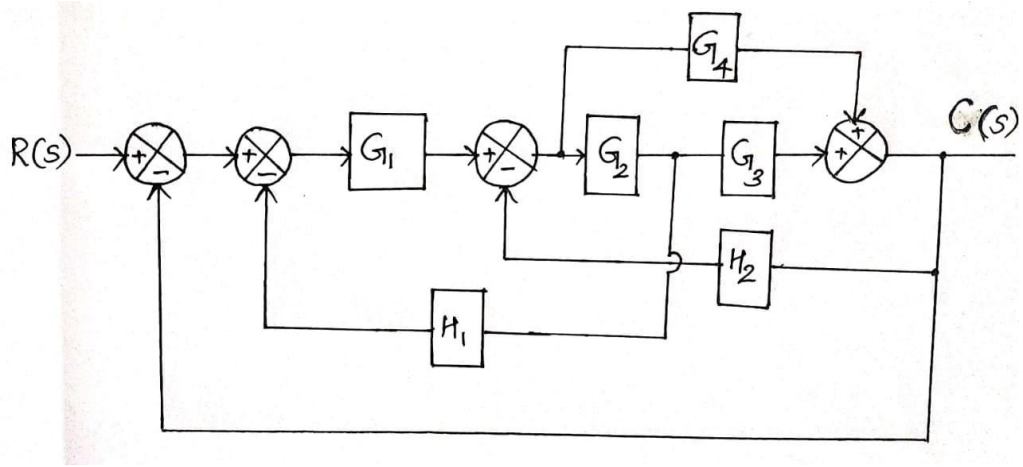
b) Derive an expression for time response of second order under damped system to step input. (8)

3 a) The unity feedback system is characterised by an open loop transfer function G(s) = (7)

$\frac{K}{s(s+10)}$.Determine the gain K so that the system will have a damping ratio of 0.5 for this

value of K. Determine the settling time, peak overshoot, rise time and peak time for a unit step input.

b) Obtain the closed loop transfer function C(s)/R(s) of the system using block reduction technique. (8)



PART B

Answer any two full questions, each carries 15 marks.

4 a) Sketch the root locus for the unity feedback system whose open loop transfer function is (9)

G(s)H(S) = $\frac{K}{s(s+4)(s^2+4s+20)}$.

b) The characteristic polynomial of a system is $s^7+9s^6+24s^5+24s^4+24s^3+24s^2+23s+15=0$. (6)

Determine the location of roots on s-plane and hence comment on the stability of the system using Routh-Hurwitz criterion.

5 a) Sketch the Bode diagram for the following transfer function. (10)

G(s)= $\frac{75(1+0.2s)}{s(s^2+16s+100)}$.Determine gain margin and phase margin.

b) State and explain Nyquist stability criteria (5)

6 a) Explain frequency domain specifications (6)

b) Describe the design procedure for a lag compensator. (9)

PART C

Answer any two full questions, each carries 20 marks.

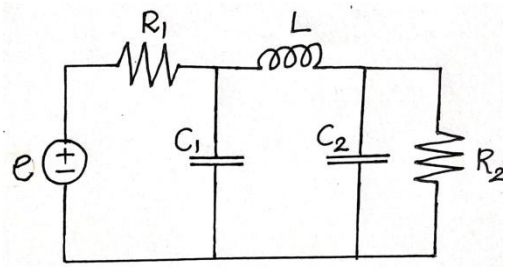
7 a) Determine the controllability and observability of the given system. (5)

$$\begin{bmatrix}\dot{x}\\ \dot{y}\end{bmatrix} = \begin{bmatrix}-0.5 & 0\\ 0 & -2\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u(t)$$

$$y(t) = \begin{bmatrix}0 & 1\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix}$$

b) A system is described by the transfer function $\frac{Y(s)}{U(s)} = \frac{10(s+4)}{s(s+2)(s+3)}$.Find the state and output equations of the system. (10)

c) Obtain the state space representation of the electrical system. (5)



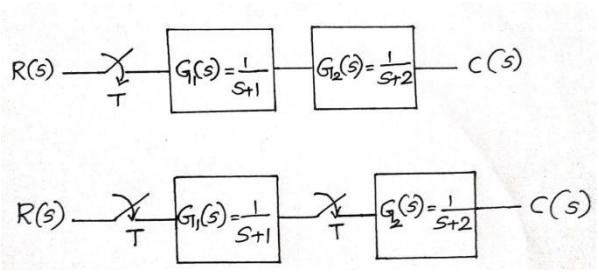
8 a) The input-output relation of a sampled control system is described by the equation (5)
c(k+2) +3c(k+1)+4c(k) = r(k+1)-r(k).Determine the z transfer function.

b) Determine the stability of a sampled data control system having the following characteristic polynomial (10)
z^4-1.7z^3+1.04z^2-0.268z+0.024=0

c) Derive the transfer function of a zero order hold circuit. (5)

9 a) List out the properties of state transition matrix. Obtain the state transition matrix of (10)
$A=\begin{bmatrix} 2 & 0 \\ -1 & 2 \end{bmatrix}$

b) Determine the pulse transfer function for the system represented by the block diagram. (10)



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