Total Pages: 3

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: AE301

Course Name: CONTROL SYSTEM(AE)

Max. Marks: 100 Duration: 3 Hours

Graph sheets and semi log sheets to be supplied.

PART A

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

1 a) Why transfer function approach need zero initial condition? (3)

b) Write any 2 advantages and any 2 disadvantages of closed loop control systems. (2)

c) Obtain the overall transfer function $\frac{C}{R}$ from the signal flow graph shown in fig. 1 (10)

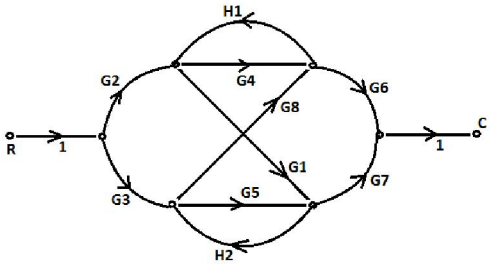


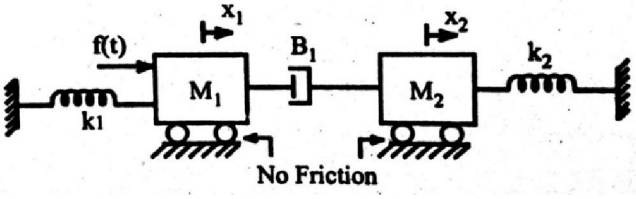
Fig. 1

2 a) The closed loop transfer function of a second order system is given by $\frac{200}{s^2+20s+200}$. Determine the damping ratio and natural frequency of oscillation (3)

b) What is the difference between order and type of a system? (2)

c) Evaluate the static error constants for a unity feedback system having a forward path transfer function G(s) = $\frac{50}{s(s+10)}$. Estimate the steady state errors of the system for the input r(t) given by r(t) = $1 + 2t + t^2$ (10)

3 a) Obtain the differential equations of mechanical system and hence draw the electrical analogous circuit based on force current analogy. (8)



b) The open loop transfer function of a unity feedback control system is given by G(s) = $\frac{K}{S(ST+1)}$ where K and T are positive constants. By what factor should the (7)

amplifier gain be reduced so that the peak overshoot of unit step response of the system is reduced from 75% to 25%?

PART B

Answer any two full questions, each carries 15 marks.

4 a) For a unity feedback system, the open loop transfer function is given by (10)

$G(s) = \frac{K}{s(s^2+6s+10)}$

Sketch the root locus for $0 \leq K \leq \infty$

b) Explain BIBO stability (2)

c) Find the value of K for which the unity feedback system $G(s) = \frac{k}{s(s+2)(s+4)}$ cross (3) the imaginary axis

5 a) Construct the Bode plot for unity feedback control system with G(s) = $\frac{10(s+10)}{s(s+2)(s+5)}$. Find its gain margin and phase margin. (10)

b) Explain Nyquist stability criterion. What is Nyquist Contour? (2)

c) Explain minimum and non-minimum phase system (3)

6 a) The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{S(S+2)(S+4)(s^2+6s+25)}$. By applying the Routh criterion , discuss the stability of the closed loop system as a function of K. Determine the value of K which will cause sustained oscillations in the closed loop system. What are the corresponding oscillating frequencies? (7)

b) For the given system $G(s) = \frac{K}{S(1+0.5s)(1+4s)}$; sketch the Nyquist plot and determine the value of K so that (i) Gain margin is 20db and (ii) phase margin is 30^o. (8)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive the state space model of armature controlled dc motor. (8)

b) Compute the transfer function of system represented by (8)

$\dot{X} = \begin{bmatrix} -2 & -2 \\ 4 & -8 \end{bmatrix} X + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U$; Y = [1 0] U

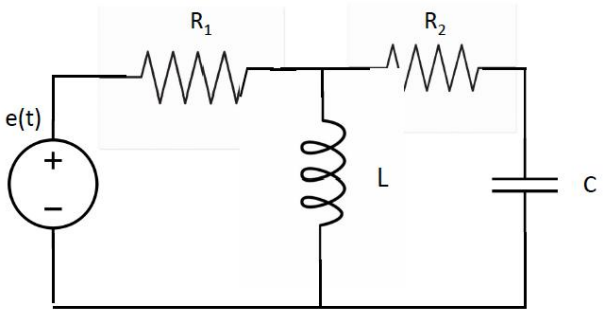
c) What is a state variable? What are the main advantages of state space representation? (4)

8 a) For a system represented by state equation $\dot{X(t)}$ = A X(t). The response is (12)

$X(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ and $X(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $X(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$.

Determine the system matrix A and the state transition matrix.

b) Obtain the state model of the electrical network shown. (8)



9 a) Examine the controllability and observability of the given system $\dot{X}$ =AX+BU ; (10)

Y = CX. Where A = $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & -3 \end{bmatrix}$, B = $\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, C^T= $\begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}$

b) A feedback system is characterized by the closed loop transfer function (10)

$$T(s) = \frac{s^2+3s+3}{s^3+2s^2+3s+1}$$

Construct a canonical state model of the system.

****