Exam.Code:1018
Sub. Code: 35258

2056

M.E. Electrical Engineering (Power Systems)

Second Semester

EE (PS)-8203: Digital Control System

Time allowed: 3 Hours Max. Marks: 50

NOTE: Attempt <u>any five</u> questions. Use of graph paper is allowed.

x-x-x

1. a) Explain natural sampling and flat-top sampling with diagrams and comparison.

   b) A system has an analog transfer function

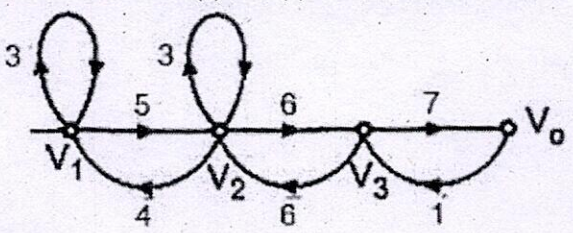
   $G(s) = \frac{s+4}{s(s+2)(s+5)}$ Find the pulse transfer function for T=0.1seconds using zero-order hold. (2x5)

2. a) Find the inverse Z-transform of

$$X(z) = \frac{z}{(z-0.5)(z-2)}$$

   Find inverse Z-transform for: (i) |z|>2| (ii) 0.5<|z|<2.

   b) Calculate the transfer function $T(s)=V_o(s)/V_1(s)$ using Mason's gain formula



(2x5)

3. a) For the system with the open-loop transfer function:

$$G(s) = \frac{K(s+1)}{s(s+4)(s^2+6s+25)}$$

   Sketch the root locus and: (i) Find the locations of the poles and zeros, (ii) asymptotes & centroid, (iii) angle of departure and (iv) value of K for stability

   b) Find the stability of a discrete-time system with the characteristic polynomial:

   $D(z) = z^5 - 0.2z^4 - 0.6z^3 + 0.4z^2 + 0.3z - 0.1$ using Jury's stability test.(2x5)

P.T.O.

4. a) For the transfer function

$$T(s) = \frac{9}{s^2 + 6s + 9}$$

Determine :(i) Damping ratio (ii) Peak overshoot (iii) Resonant frequency (iv) Resonant peak (v) Bandwidth (vi) Settling time for 2% criterion

b) Determine the value of K for stability of the following system using polar plot:

$$G(s) = \frac{K}{s\,(1+s)(1+3s)}$$

And also determine Gain Margin and Phase Margin. (2x5)

5. a) Using Nyquist criterion, determine the stability of

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

Find the critical gain for stability.

b) Why is logarithmic scale used in Bode plots? Explain the advantages of Bode plot over other frequency response methods. (2x5)

6. a) Given the continuous-time transfer function:

$$G(s) = \frac{10\,(s+2)}{s^2 + 4s + 5}$$

Convert this to a discrete-time transfer function using the bilinear transformation with a sampling period of T = 0.2 seconds.

b) A system is described by

$$\frac{d^3x(t)}{dt^3} + 4\frac{d^2x(t)}{dt^2} + 5\frac{dx(t)}{dt} + 2x(t) = u(t)$$

Write state equations and output equation. (2x5)

7. a) A linear time-invariant system is described by the state-space model:

$$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \quad C = [1 \quad 1]$$

(i) Determine whether the system is completely controllable,

(ii) Determine whether the system is observable

(iii) Comment on the physical significance of your results.

b) Describe the procedure to check stability of an equilibrium point using Lyapunov's direct method. Discuss the limitations of Lyapunov stability analysis. (2x5)

8. a) Discuss digital control techniques used for stepper motors. Explain applications of stepper motors in robotics and automation.

b) Explain step-by-step procedure for pole placement using state feedback. Design a state feedback controller using pole placement for a given system. (2x5)

x-x-x