



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

Note: There is a sampler at the input of G(s).

22. a) (i) Consider the following characteristic equation of a discrete-data system:  $z^3 - 1.1z^2 - 0.1z + 0.2 = 0$ . Check for stability using Jury's stability test. (7)

- (ii) Check for stability of the sampled data control system represented by the following characteristic equation:  $z^3 - 0.2z^2 - 0.25z + 0.05 = 0$  using bilinear transformation. (7)

(OR)

- b) (i) Write the general procedure for constructing Root Loci. (10)  
 (ii) Explain the concept of Nyquist stability criterion. (4)

23. a) (i) Check whether the following system is completely observable (7)

$$\begin{aligned} x(k+1)T &= Gx(kT) + Hu(kT) \\ y(kT) &= Cx(kT) \end{aligned}$$

$$G = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix}, H = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, C = [1 \ 0 \ 0]$$

- (ii) A discrete time system has the transfer function  $\frac{Y(z)}{U(z)} = \frac{2(z+3)}{(z+2)(z+3)(z+4)}$ . Determine the state model of the system in canonical form. (7)

(OR)

- b) (i) A system is described by the following state equation (10)

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

Design a state feedback controller so that the closed loop poles are placed at -2,  $-1 \pm j1$ .

- (ii) Explain the relationships between controllability, observability and transfer functions. (4)

24. a) (i) Design a dead beat controller for a first order process whose transfer function is given by  $G_p(s) = 1/0.4s + 1$ . The sampling period  $T = 1$ . (7)

- (ii) Write the design procedure for digital compensator using frequency response method. (7)

(OR)

- b) (i) Derive the position form of PID algorithm. (7)

- (ii) Enumerate the benefits of velocity form of PID algorithm. (7)

25. a) (i) Explain how a temperature process is controlled using a microprocessor. (7)

- (ii) Draw the flowchart which depicts the control algorithm in a microprocessor for temperature process. (7)

(OR)

- b) (i) Explain the operational features of stepper motor. (7)

- (ii) Draw a general block diagram of a digital control system using microprocessors and explain. (7)

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