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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Electrical and Electronics Engineering

Semester End Examination; June - 2017

Discrete Time Control System

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

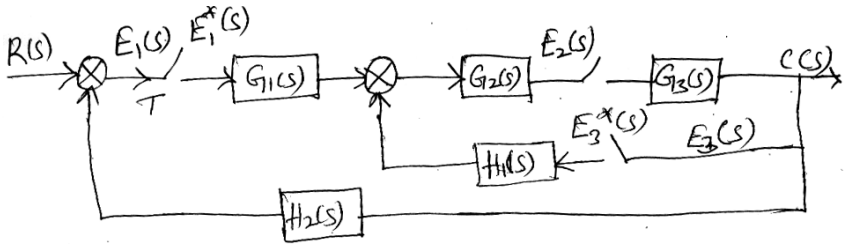
UNIT - I

1 a. What are the advantages of Discrete Time Control System over a Continuous Time Control Systems? 10

b. With block diagram, explain the practical circuit of Sample and Hold circuit. 10

2 a. What are the properties of Z-transformation? Prove any two of them. 10

b. Consider the multi-loop multi-sampler digital control system shown in below figure. Find the closed-loop transfer function for this system. 10



UNIT - II

3 a. Explain the mapping between S-plane to Z-plane. 8

b. Explain the different methods available for checking the stability of sampled data control systems. 12

4 a. The characteristic equation of a sampled data system is given by :

$$Z^4 - 0.9Z^3 + 0.14Z^2 + 0.216Z + 0.03Z = 0$$

By Jurg's test investigate the stability of the system and verify the result by the method of bilinear transformation. 12

b. Explain static and steady state error constants of DTCS. 8

UNIT - III

5 a. Define the following with respect to state space analysis :

i) State

ii) State variable 8

iii) State vector

iv) State space.

Contd…2

b. Pulse transfer function of a system to is given by:

$$\frac{Y(Z)}{u(Z)} = \frac{3Z}{(Z+1)^2(2Z+1)}$$ 12

Obtain the state model realization in,

i) Controllable canonical form ii) Observable canonical form.

6 a. State all the properties of state transition matrix (STM). 8

b. A discrete-time system is represented by the state model :

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -0.16 & 1 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} r(k)$$

$$y(k) = [1 \quad 0]\, x(k),\ x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$ 12

Determine a discrete-unit step response of the system, also obtain the pulse transfer function.

UNIT - IV

7 a. Determine whether or not the following quadratic form is negative definiteness.

$$Q = -x_1^2 - 3x_2^{\,2} - 11x_3^{\,2} + 2x_1x_2 - 4x_2x_3 - 2x_1x_3$$ 10

b. Explain the Liapunov stability analysis for linear time invariant continuous time systems. 10

8 a. Consider a second – order autonomous system given by

$$x_1(k+1) = x_2(k),\ x_2(k+1) = 5x_1(k) - 8x_2(k)$$ 12

Generate a Liapunov function and investigate stability of the system.

b. Explain asymptotic stability, stability in large and instability. 8

UNIT - V

9 a. Explain state controllability and observability with Kalman's test. 10

b. Explain the principle of duality. 10

10a. Consider a system is described by,

$$F = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix};\ G = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$ 12

Using state feedback control u (k) = -k x(k),

It is desired to have poles at Z = -0.2 ± j0.5 and Z = - 0.8, determine the state feedback gain matrix 'k'.

b. Explain the design procedure for state observers. 8

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