UPTU Notes

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B.TECH
(SEM VI) THEORY EXAMINATION 2017-18
DIGITAL CONTROL SYSTEM

Time: 3 Hours **Total Marks: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief. **2 x10 = 20**

a) Explain acquisition time for sample and hold operation.

b) If $X(z) = 2+3Z^{-1}+4Z^{-2}$ then find the initial and final value of the corresponding sequence.

c) What are advantages of a control system designing with a high gain feedback?

d) What do you by insensitive controllers?

e) Explain the concepts of observability.

f) What do you mean by the state of digital processor?

g) What are the uses of Lyapunov stability in adaptive control system?

h) What do mean by the stability in sense of Lyapunov?

i) Explain the principle of optimality.

j) What do you mean by dynamic programming?

SECTION B

2. Attempt any three of the following: **10 x 3 = 30**

a) Derive the transfer function of the following data hold circuit.

i. Zero order hold circuit.

ii. First order hold circuit.

b) Explain general structure of a digital structure of a control system.

c) Discuss some merits and demerits if representing state model into

i. Physical variable form

ii. Phase variable form

iii. Conical variable form

d) Explain Jury stability criterion. Also list the difference between the Jury stability test and stability analysis using bilinear transformation coupled with Routh stability criterion.

e) Derive an expression for the discrete Euler-Lagrange equation.

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SECTION C

3. Attempt any one part of the following: 10 x 1 = 10

a) Obtain the Z-transform of the following:

(i) $X(S) = \frac{a}{s^2(s+a)}$ (ii) $X(S) = \frac{s}{(s^2 - a^2)}$

b) What do you understand by z-transform? Explain the relationship between the Laplace transform and the Z-transform. Define the constant-Damping Loci.

4. Attempt any one part of the following: 10 x 1 = 10

a) What do you mean by transient accuracy of a non unity feedback discrete time system?

b) Explain the designing of a digital compensator using Root Locus.

5. Attempt any one part of the following: 10 x 1 = 10

a) A system is described by-

$$\dot{x} = \begin{bmatrix} -1 & -4 & -1 \\ -1 & -6 & -2 \\ -1 & -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = [1 \quad 1 \quad 1]x$$

Find the transfer function and construct the signal flow graph.

b) Construct the state model for the system characterized by the differential equation-

$$\frac{d^3y}{dt^3} + \frac{6d^2y}{dt^2} + \frac{11dy}{dt} + 6y = u$$

Give the block diagram representation of the state model.

6. Attempt any one part of the following: 10 x 1 = 10

a) Consider the discrete time unity feedback control system (T=1 sec) whose open loop pulse transfer function is given by

$$G(z) = \frac{K(0.3679Z + 0.2642)}{(Z - 0.3679)(Z - 1)}$$

Determine the range of K for stability by use of the Jury stability test.

b) Explain in detail the second method of the Liapunov.

7. Attempt any one part of the following: 10 x 1 = 10

a) Explain and derive an expression for the discrete maximum or minimum principle.

b) Explain the time-optimal control with energy constraint in detail.

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