B.E. ELECTRICAL ENGINEERING FOURTH YEAR FIRST SEMESTER - 2018

DIGITAL CONTROL TECHNIQUES (ELECTIVE-I)

Time : 3 hours | Full Marks : 100

Answer any FIVE questions.

Answer all parts of a question in the sequential order.

1. a) Explain with neat sketches, the various dynamic characteristics observed in the Sample and Hold operations during the A/D conversion of a time-varying analog signal.

b) Explain with suitable example, what will happen if A/D conversion is attempted for a time varying signal with arbitrary frequency content without deploying a hold circuit?

[10+10=20]

2.a) State and explain Jury's Stability test for a discrete-time closed-loop system.

b) Consider the system described by following mathematical model:

$$y(k)-0.7y(k-1)-0.72y(k-2)+0.69y(k-3)-0.15y(k-4)=x(k)$$

Where $x(k)$ is the input and $y(k)$ is the output of the system. Test the stability of the system.

[10+10=20]

3a) Derive the steady-state errors of Type-0, Type-1 and Type-2 LTI discrete-time control systems in response to standard test signals.

b) Explain the significance of bilinear transform in the digital control theory.

[15+5=20]

4 The feed-forward pulse transfer function of a unity gain feedback discrete-time control system is given as:

$$G(z)=\frac{Kz}{(z-1)}\cdot\frac{(1-e^{-T})}{(z-e^{-T})}$$

Where K is the variable gain of the controller. Draw the Root-locus diagram for the above system for T=0.1 sec.

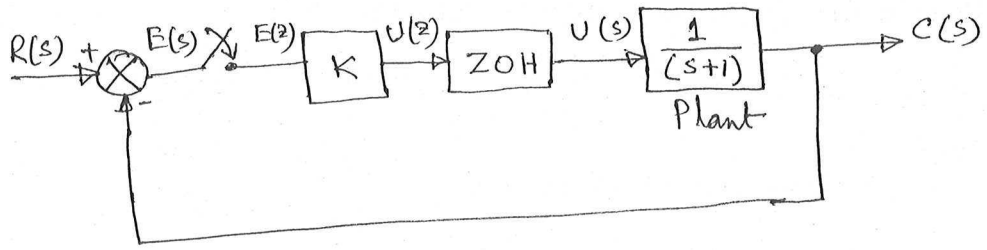
[20]

5.a) Explain with example, the principle of mapping between s-plane and z-plane. Comment on the stability property in z-plane.

b) What is the significance of Zero Order hold in analog signal reconstruction from the signal output from D/A converter? Derive the transfer function of Zero Order hold circuit.

[10+10=20]

6. A discrete-time closed-loop system is shown below:



K is the gain of the proportional controller. The sampling time is 0.1 sec.

a) Obtain the closed-loop pulse transfer function.

b) For K=10, derive the step response of the system and plot the result.

[20]

7.a) Show the non-uniqueness of the discrete-time state-space representation.

b) Solve the LTI discrete-time state equation and hence derive the state-transition matrix.

c) State and explain the Controllability and Observability conditions of LTI discrete-time systems.

[6+6+8=20]

8. Write short notes on *any two* from the following:

a) Discrete-time PID Controller design.

b) Selection of sampling frequency for a Digital Control System implementation.

c) Various types of signals associated at different parts of a Digital Control System.

d) Closed-loop Pulse Transfer Function for deployment of the samplers at different locations of the system.

[10+10=20]