Register Number:……..

B.E., DEGREE EXAMINATIONS MAY/JUNE 2013

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

EIE111: Digital Control Systems

Time: Three Hours **Maximum Marks: 100**

Answer ALL Questions:-

PART A (10 x 1 = 10 Marks)

1. Sampling rate =
   A. reciprocal of sampling frequency B. sampling period
   C. two times the sampling frequency D. reciprocal of sampling period

2. Z-transform of 1 (Z[1]) =
   A. $1/1-z^{-1}$ B. $1-z^{-1}$ C. $1/1-z$ D. 1

3. In root locus plot the angle of departure of root locus from complex open loop pole is
   (Let Φ = Net angle contribution at this pole of all other open loop poles and zeros)
   A. $180^o + \Phi$ B. $180^o + 2\Phi$ C. $180^o - \Phi$ D. $360^o - \Phi$

4. The bilinear transformation is defined as s =
   A. $\frac{T}{2}\left(\frac{z-1}{z+1}\right)$ B. $\frac{2}{T}\left(\frac{z+1}{z-1}\right)$ C. $\frac{T}{2}\left(\frac{z+1}{z-1}\right)$ D. $\frac{2}{T}\left(\frac{z+1}{z-1}\right)$

5. State trajectory in two dimensional case are referred as
   A. vector trajectory B. phase trajectory C. phase plane D. state vector

6. If state variables are estimated from inputs and outputs of the system, then the system is
   A. Completely controllable B. Completely absorbable
   C. Completely Stable D. Unstable

7. Frequency response of G_{ho} G(z) are obtained by setting z = _____ and letting ω range = _____
   A. $e^{j\omega t}$, 0 to $\omega_s/2$ B. $e^{j\omega t}$, $-\omega_s/2$ to $\omega_s/2$
   C. $e^{-j\omega t}$, $-\omega_s/2$ to $\omega_s/2$ D. $e^{-j\omega t}$, 0 to $\omega_s/2$

8. Most of the systems are designed with peak overshoot value of _____
   A. 5 to 25% B. 25 to 40% C. Less than 5% D. Greater than 40%

9. The digital position control system has a
   A. Servo motor B. Variable reluctance type motor
   C. Drive amplifier D. Sequence logic

10. Which one of the following is more suitable for stepper motor?

A. Available in very high power rating B. It does not have holding torque

C. Suitable for low speed applications D. Not used in open loop systems

PART B (10 x 2 = 20 Marks)

11. Obtain the difference equation for the system X (z)/Y(z) = $Z^2 + 4$.
12. Give the steady state error for type 0 and type 1 system for various standard inputs.
13. In root locus plot, when gain k increased from 0 to infinity, how many loci will terminate on infinity?
14. State the rules to form Jury Stability tale.
15. Define state of a dynamic system.
16. What is meant by stability of a system in the sense of lyapunov?
17. Define gain margin.
18. What is meant by dominant pole?
19. List the steps to implement control algorithm in a microprocessor.
20. What is meant by pull-in range of a stepper motor?

PART C (5 x 14 = 70 Marks)

21. a) (i) Obtain the pulse transfer function for zero order hold. (7)

(ii) Obtain the steady state error for various types of standard inputs for the system described by the difference equation y (k-1) + 4y (k-2) + 5y (k-3) = 5x (k) + 8x (k-2). (7)

(OR)

b) For the sample data control system, C(s) / R(s) = $\frac{1 - e^{-sT}}{s} \times \frac{1}{S + 1}$ Find the step response. Assume T = 1 sec.

22. a) (i) Using bilinear transformation obtain H (z) for the system (7)

H(s) = $\frac{1}{(S + 1)^2}$.

(ii) Analyze the stability of the system G (z) using Jury Stability Test. The characteristics equation of G (z) is given by $z^4 - 1.368\ z^3 + 0.4\ z^2 + 0.08\ z + 2 = 0$. (7)

(OR)

b) For the sample data control system, C(s) / R(s) = $\frac{1-e^{-sT}}{s} \times \frac{K}{s(s+1)}$. Sketch the root locus plot on the z-plane and from there obtain the value of K that results in marginally stable. Assume T =1 sec.

23. a) Consider the system

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u; \quad x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad y = \begin{bmatrix} 1 & 0 \end{bmatrix} x,$$

Find the output response of the system to unit-step input.

(OR)

b) Determine the controllability and observability of the following system.

$$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}, \quad b = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix}, \quad c = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$

24. a) Consider the system with transfer function G(s) = $\frac{1-e^{-sT}}{s} \times \frac{1}{(s+1)(s+2)}$,

T = 1 sec, Design a compensator D (z) using root locus technique, that meets the following specifications on the system performance.

1. $\xi = 0.5$
2. $\omega_n = 1.5$
3. $K_p \geq 7.5$

(OR)

b) Consider a system with transfer function G (s) = $\frac{1-e^{-sT}}{s} \times \frac{1}{s(s+2)}$,

T = 0.1 sec. Design a lag compensator that results in 55^o phase margin with $K_v = 5$

25. a) How will you interface stepper motor with microprocessor and explain with suitable circuit and input sequence?

(OR)

b) Design control algorithm for a position control system.

****