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Register Number: ………………..

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

EIE111**:** Digital Control System

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The Z-transform of unit impulse sequence is _____.

    a) 1

    b) $\dfrac{Z}{Z-a}$

    c) $\dfrac{Z}{Z-e^{aT}}$

    d) $\dfrac{Z}{Z-1}$

2. The transfer function of the Zero order hold is _____.

    a) $\dfrac{1-e^{-ST}}{S}$

    b) $\dfrac{1+e^{-ST}}{S}$

    c) $\dfrac{1-e^{-ST}}{S+1}$

    d) $\dfrac{1-e^{-ST}}{S^2}$

3. In Nyquist stability criterion, if the contour in the s plane encloses equal numbers of poles & zeros, then the corresponding closed curve in F(s) plane _____.

    a) Encircle the origin of F(s) plane

    b) one encirclement of the origin of F(s) plane in clockwise direction

    c) Does not encircle the origin of F(s) plane

    d) one encirclement of the origin of S plane

4. In stability analysis using bilinear transformation coupled with Routh stability criterion the mapping equation is given by _____.

    a) $Z = \dfrac{w+1}{w-1}$

    b) $w = \dfrac{z+1}{z-1}$

    c) $Z = \dfrac{w-1}{w+1}$

    d) Both (a) & (b)

5. For a continuous time system, controller design using pole placement technique involves selection of desired closed loop poles to be _____ when compared to open loop poles.

a) More positive
b) More negative
c) Same
d) In right half of s-plane

6. The Lyapunov stability analysis is based on the concept of _____.

a) Energy
b) Power
c) State variable
d) Energy & Power

7. The relationship between Z plane and fictitious w plane is given by _____.

a) $w = \dfrac{2}{T}\dfrac{z-1}{z+1}$
b) $w = \dfrac{4}{T}\dfrac{z-1}{z+1}$
c) $w = \dfrac{6}{T}\dfrac{z-1}{z+1}$
d) $w = \dfrac{8}{T}\dfrac{z-1}{z+1}$

8. Estimation of unmeasurable state variable with a help of a computer program is called as _____.

a) Estimator
b) State Observer
c) Compensator
d) State Controller

9. In a digital temperature control system the final control element is _____.

a) Control Valve
b) Triacs
c) Amplifier
d) Shaft encoder

10. To Convert a digital input into a mechanical motion, the device used is _____.

a) Servo Motor
b) Stepper Motor
c) Potentiometer
d) RTD

PART B (10 x 2 = 20 Marks)

11. Define Shannon's sampling Theorem.

12. Obtain the steady state value of a ramp signal.

13. Mention the different methods of stability analysis of sampled data control system.

14. What are the necessary & sufficient conditions to be satisfied for the stability of digital system with regard to jury's stability test?

15. Draw the general state diagram for a digital control system.

16. Define the Positive semi definiteness of a scalar function.

17. Write the transfer function of the simple lead compensator model in w plane.

18. What is a Deadbeat algorithm?

19. Mention the difference between absolute encoder and incremental encoder.

20. What are the different areas of application of stepper motor?

PART C (5 x 14 = 70 Marks)

21. a) (i) Obtain the z transform of $X(s) = \frac{1}{s(s+1)}$ (7)

   (ii) Find x(k) for k=0,1,2,3,4 when X(z) is given by $X(z) = \frac{10z+5}{(z-1)(z-0.2)}$ (7)

(OR)

   b) For the sampled data control system shown in the figure below find the response to unit step input.
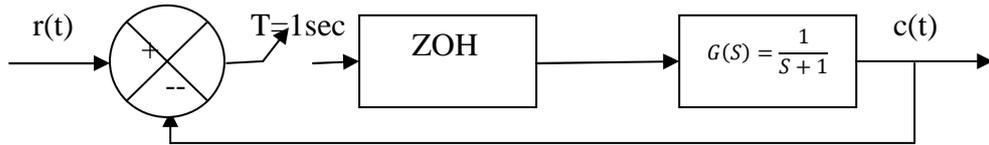
22. a) (i) Check for the stability of the sampled data control system represented by the following characteristics equation by Jury's stability Test. (7)

   $Z^3 - 1.3Z^2 - 0.08Z^1 + 0.24 = 0$

   (ii) Check for the stability of the sampled data control system represented by the following characteristics equation by Bilinear Transformation (7)

   $Z^3 - 0.2Z^2 - 0.25Z + 0.05 = 0$

(OR)

   b) (i) Explain in detail about the Nyquist Stability Criterion with necessary diagrams. (7)

   (ii) Derive the relation between Z and S domain. (7)

23. a) (i) Obtain the three different realizations for the transfer function (7)

   $$G(s) = \frac{s + 3}{s^3 + 9s^2 + 24s + 20}$$

   (ii) Examine the controllability and observability of the system given below (7)

   $$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \\ x_3(k+1) \end{bmatrix} = \begin{bmatrix} 1 & 1 & -1 \\ 1 & 3 & -1 \\ -2 & 2 & 3 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \\ x_3(k) \end{bmatrix} + \begin{bmatrix} -2 \\ 5 \\ 7 \end{bmatrix} u(k)$$

   $$y(k) = [-6 \quad -1 \quad 3] \begin{bmatrix} x_1(k) \\ x_2(k) \\ x_3(k) \end{bmatrix}$$

(OR)

   b) (i) Consider the nonlinear system described by $\dot{x}_1 = x_2$ & $\dot{x}_2 = -x_1 - x_2^3$. (7)

   Investigate the stability using direct method of Lyapunov.

(ii) Determine the stability of the system described by the following equation (7)
$x(k + 1) = Fx(k)$ using Lyapunov stability analysis

$$F = \begin{bmatrix} -1 & -2 \\ 1 & -4 \end{bmatrix}$$

24. a) Consider a digital feedback control system with a compensator $D(Z)$, a zero order hold G_{ho} (S) and the plant represented by $G(S)$. The plant is described by the transfer function $G(S) = \frac{K}{S(S+5)}$ .Design a digital control scheme for the system to meet the following specification.
(i) $K_v = 10$
(ii) $Phase\ Margin \cong 40°$ and (iii) $Bandwidth \cong \frac{12rad}{sec}$.

(OR)

b) Design the deadbeat control algorithm for the process transfer function $G_P(S) = \frac{1}{0.4S+1}$, where sampling period T=1Sec.

25. a) Explain the implementation of Digital Temperature Control System with a neat block diagram. Also detail its control algorithm.

(OR)

b) Explain in detail the digital measurement of shaft position and the digital position control system with necessary diagrams.

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