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Register Number:……………………..

B.E DEGREE EXAMINATIONS : NOV / DEC 2014

(Regulation 2009)

Sixth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

EIE111: Digital Control Systems

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The settling time of a process curve is given by ______________.
   a) $4\zeta/\omega_n$ b) $4/\zeta\,\omega_n$
   c) $4\,\omega_n/\zeta$ d) $4/\zeta^2\,\omega_n$
2. The transfer function of the Zero order hold is ________________.
   a) $\frac{1-e^{-ST}}{S}$ b) $\frac{1+e^{-ST}}{S}$
   c) $\frac{1-e^{-ST}}{S+1}$ d) $\frac{1-e^{-ST}}{S^2}$
3. The root locus technique determines the stability of the system in _______________.
   a) Time Domain b) w Plane
   c) Frequency Domain d) U Plane
4. The bilinear transformation maps the interior of unit circle in the Z plane into the ___________.
   a) left half of r plane b) right half of r plane
   c) encirclement of the F(s) plane d) outside the unit circle of z plane
5. The Lyapunov stability analysis is based on the concept of ____________.
   a) Energy b) Power
   c) State variable d) Energy & Power
6. The State Transition Matrix is also called __________ Matrix.
   a) Transformation b) State
   c) Fundamental d) Approximation

7. The Specification of Deadbeat algorithm is represented by _______________.

a) Z^2 b) Z^{-1}

c) Z^3 d) Z^{-2}

8. The relationship between Z plane and fictitious w plane is given by ______________.

a) $w = \frac{2}{T}\frac{z-1}{z+1}$ b) $w = \frac{4}{T}\frac{z-1}{z+1}$

c) $w = \frac{6}{T}\frac{z-1}{z+1}$ d) $w = \frac{8}{T}\frac{z-1}{z+1}$

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. Derive the Steady State Equation for a Ramp Input.
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 using Jury's stability test?
15. Obtain the Z Transform of $\mathbf{G}^k$ where **G** is a n x n Constant Matrix.
16. What is meant by Pole Placement Technique?
17. Write the transfer function of the simple lead compensator model in w plane.
18. What is meant by Deadbeat algorithm?
19. Mention the difference between absolute encoder and incremental encoder.
20. What are the different areas of application of stepper motor?

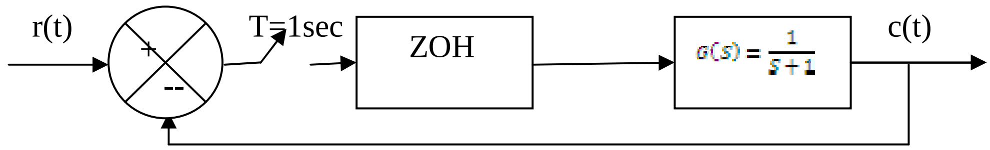
PART C (5 x 14 = 70 Marks)

21. a) (i) Determine the one sided z-transform for $\cos\omega t$ & $\sin\omega t$. (7)

(ii) Determine the inverse z-transform of $F(Z) = \frac{1}{1-1.5Z^{-1}+0.5Z^{-2}}$ (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) Examine the controllability and observability of the system given below

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

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

(OR)

b) A Single Input System is Described by the following equation.

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -2 & 0 \\ 2 & 1 & -3 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 10 \\ 1 \\ 0 \end{bmatrix} u$$

Design a state feedback controller which will give closed loop poles at

-1+2i ; -1-2i ; -6

24. a) Illustrate the procedures for designing the following

(i) Lead Compensator Design using Root Locus Method. (7)

(ii) Lag Compensator Design using Root Locus Method. (7)

(OR)

b) Design the deadbeat control algorithm for the process transfer function for

$G_p(S) = \frac{e^{-0.8S}}{0.6S+1}$,where sampling period T=0.4 Sec

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

(OR)

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

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