Reg. No. :

Question Paper Code: 47602

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Seventh Semester

Instrumentation and Control Engineering

14UIC702 - DIGITAL CONTROL SYSTEM

(Regulation 2014)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The type of systems which are characterized by input and the output quantized at certain

    Levels are called as

    (a) analog   (b) discrete

    (c) continuous   (d) digital

2. In the sampled data control system, the controller output is given to

    (a) Comparator   (b) Process   (c) Final control element   (d) Zero order hold

3. Shanon's sampling theorem states

    (a) $f_s \geq f_m/2$ (b) $f_s \leq f_m/2$ (c) $f_s \geq 2f_m$ (d) $f_s \leq 2f_m$

4. The holding device which uses n^{th} order polynomial for approximation is called

    (a) $(n+1)^{th}$ order holding   (b) $(n-1)^{th}$ order holding device

    (c) n^{th} order holding device   (d) Zero order holding device

5. Z-transform of 6 δ (k+2) is

    (a) $\frac{6z}{z-2}$ (b) $6z^2$ (c) $2z^6$ (d) $6z^{-2}$

6. The stable region of Z plane is

    (a) Inside the unit circle   (b) Outside the unit circle

    (c) Left half plane   (d) Right half plane

7. For the nth order system, the number of state equations will be

    (a) 1   (b) n   (c) (n+1)/2   (d) n/2

8. A state space model is fundamentally different from transfer function model in account of

    (a) Zeroes   (b) Single input & single output

    (c) Initial conditions   (d) Poles

9. The input of a controller is

    (a) Sensed signal

    (b) Error signal

    (c) Desired variable value

    (d) Signal of fixed amplitude not dependent on desired variable value

10. In dead beat controller C(z) / R(z) is

    (a) z^{-2} (b) z^{-1} (c) z^{-n} (d) z^{+1}

<div align="center">PART - B (5 x 2 = 10 Marks)</div>

11. Distinguish digital controllers and analog controllers.

12. Define acquisition time, aperture time and droop rate with respect to sample and hold operation.

13. State and prove convolution theorem in z-transform.

14. Define Controllability and observability in state space approach.

15. State deadbeat algorithm

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16.(a) Draw the configuration of basic digital control and explain the functions of each

component in it..   (16)

Or

(b) Describe in detail the configuration of the basic digital control scheme.   (16)

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17. (a) Write a detailed technical note on Frequency domain analysis with examples   (16)

Or

(b) (i) Derive the transfer function of Zero Order Hold.   (8)

(ii) Illustrate the significance of various time domain modes of discrete time systems.

.   (8)

18. (a) For the sampled data system given below, find the response c(k) for unit step

change in input r(k)   (16)
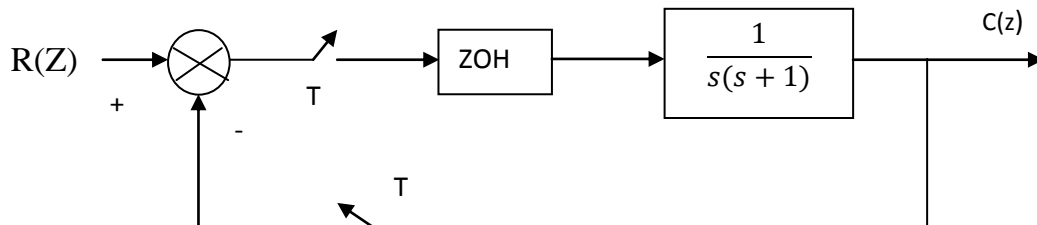
Or

(b) (i) Obtain the modified z-transform of unit ramp function.   (6)

(ii) Determine the stability using Jury's test for the system with the following

characteristic polynomial.   (10)

$$\Delta(Z) = Z4 - 1.2Z3 + 0.07Z2 + 0.3Z - 0.08$$

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19. (a) (i) Obtain the state space model for the given pulse transfer function in decoupled
    form. (8)

$$\frac{y(z)}{u(z)} = \frac{2(z+5)}{(z+2)(z+3)(z+4)}$$

(ii) Find state transition matrix $\Phi(k)$ if the system state matrix is given as (8)

$$A = \begin{pmatrix} -3 & 0 \\ 0 & -2 \end{pmatrix}$$

Or

(b) (ii) Obtain the phase variable form of state model of the following system and find the
    Controllability of the same (16)

$$y(k+3) + 6y(k+2) + 9y(k+1) + 6y(k) = u(k)$$

20. (a) Develop the position and velocity forms of a digital PI and PD controllers. (16)

Or

(b) Design a pole placement controller (using state feedback) for the given digital system
    with state model,

$$\begin{bmatrix} x_1(k+1) \\ x_1(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k)$$

The desired closed loop poles should be taken as $0.5 \pm j\, 0.5$ (16)

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