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Question Paper Code: 47602

B.E. / B.Tech. DEGREE EXAMINATION, NOV 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. A continuous-time periodic signal x(t), having a period T, is convolved with itself. The resulting signal is

(a) Not periodic (b) Periodic having a period T

(c) Periodic having a period 2T (d) Periodic having a period T

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 n^{th} 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 velocity form of PID controller computes

(a) m(n-1) – m(n) (b) m(n-1) + m(n)

(c) m(n) – m(n-1) (d) m(n) + m(n+1)

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

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

PART - B (5 x 2 = 10 Marks)

11. Distinguish between analog and discrete signals.

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

PART - C (5 x 16 = 80 Marks)

16. (a) With block diagram, describe a digital temperature control system (16)

Or

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

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17. (a) (i) Obtain the inverse Z-transformation of the discrete function (4)

$$G(z) = \frac{Z}{3(Z - 0.333)(Z-1)}$$

(ii) Derive the expression for the sampled spectra and explain aliasing effect using the frequency domain considerations. (12)

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) Compare open loop hybrid sampled data control systems and open loop discrete input data control systems (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) 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) Explain the design of state regulator and observer with suitable examples. (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)