(CBSGS)/ INST

Paper / Subject Code: 53201 / Digital Control System / NOV. 18

Duration: 3 Hours **Max. Marks 80**

N.B.

1. **Q.1** is compulsory. Attempt **any three** from the remaining questions.
2. All questions carry equal marks.
3. Figures to the Right indicate full marks.
3. Assume suitable data if necessary

Q.1 Attempt **any four** **20**

a. What is Quantization? Explain the difference between quantization and encoding.

b. Determine steady state error for unit step, ramp and acceleration inputs for the following system.

$$\frac{0.2385(z+0.8760)}{(z-1)(z-0.2644)}$$

c. Map the region from s-plane to the z-plane which is bounded by constant frequency lines at $\pm 5j$ and constant attenuation lines at ± 2.

d. Explain sampler as an impulse modulator.

e. What are the advantages of Digital Control System.

f. Obtain the pulse transfer function for the following system.

$$\begin{aligned} z(k+1) &= \begin{bmatrix} 2 & -5 \\ 0.5 & -1 \end{bmatrix} z(k) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(k) \\ y(k) &= [2 \;\; 0]\, z(k) \end{aligned}$$

Q.2 A. Explain working of ZOH device and derive its transfer function. **10**

B. What is Signal Flow Graph? Explain Mason's Gain formula by giving appropriate example. **10**

Q.3 A. Determine the values of K for asymptotic stability of the system given by characteristic equation using Jury's stability criteria **10**

$$P(z) = z^4 + 0.2z^3 - 0.25z^2 - 0.05z + K = 0$$

B. Represent the given system in companion form and Diagonal canonical form along with its block diagram realization. **10**

$$T(z) = \frac{z^3 + 8z^2 + 17z + 8}{(z+1)(z+2)(z+3)}$$

Q.4 A. Obtain state transition matrix for the system defined by **10**

$$z(k+1) = \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & -2 \\ 1 & 0 & -3 \end{bmatrix} z(k)$$

B. What is multirate sampling? Explain multirate output feedback based state estimator. **10**

Q.5 A The discrete time control system is given by **10**

$$x(k+1) = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -4 & -2 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(k)$$

Design a state feedback controller to place closed loop poles at $-0.5 \pm j0.5$ and 0.

B. Explain discrete-time PID controller in detail. **10**

Q.6 A. Design the deadbeat full order observer for the system **10**

$$\begin{aligned} x(k+1) &= \begin{bmatrix} 0.16 & 2.16 \\ -0.16 & -1.16 \end{bmatrix} x(k) + \begin{bmatrix} -1 \\ 1 \end{bmatrix} u(k) \\ y(k) &= \begin{bmatrix} 1 & 1 \end{bmatrix} x(k) \end{aligned}$$

B. Discretize the given system **10**

$$G(s) = \frac{4500K}{s(s+361.2)}$$

with $K = 14.5$ and sampling period of Ts=0.5 sec.

(CBSGS) Paper / Subject Code: 53208 / Instrument and System Design / Nov. 18

Instrumentation.

(3 Hours) Total Marks: 80

Note:

1. Question No.1 is compulsory
2. Solve any THREE questions out of remaining FIVE questions.
3. Figure to the right indicate full marks.
4. Assume suitable data if required.

Q1. Solve any 4 [20marks]

a) Explain Aerodynamic and Hydrodynamic valve noise.

b) Define control valve coefficient. Give the factors that affect this coefficient.

c) Discuss the following terms related to reliability: MTTR and MTBF

d) What is ergonomics? Give example of ergonomics applied to a product.

e) What are the design considerations of an RTD?

Q2.

a) Explain phases of Electronic product design. [10marks]

b) A 3" Butterfly valve is to operate at the following conditions- [10marks]

Fluid- Water at flow rate 330gpm

P_v = 0.4 psia, P_1= 24psia, P_2= 15psia d=3.068"

State whether the valve will cavitate or not, and if it cavitates, to what extent?

Q3.

a) Water at 15° C is flowing through 12 inch standard weight pipe (D= 12) at a rate that will not exceed 2800gpm. It is proposed that a standard 60° opening Butterfly valve be used for control. Find size required, if p_1 is computed to be 72.2psia and p_2 is 64.1psia. [10marks]

b) What is absolute calibration? Explain Thermocouple calibration using absolute method [10marks]

Q4.

a) Explain choked flow condition and expansion factor for gases. [10mark

b) Find valve size for the following conditions [10mark

Fluid - Benzene with fine non abrasive solids

$G = 0.88$

$q = 450$ gpm

$p_1 = 80$ psia

$p_2 = 71$ psia

$T_1 = 528^\circ$ R

D = 6 inch schedule 40

Valve is characterized ball with C_d=25.

Q5. Write short note on

a) Control room design layout [10mark

b) Protection standards for electrical enclosures. [10mark

Q6.

a) Explain the general selection criteria for transducers. [10marks

b) Explain with diagram methods of control valve noise reduction. [10marks]

END

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