

## ADVANCED CONTROL SYSTEM

SET-I

3K4-IFC-23

M.M. : 100

Time : 3 Hrs.

**Note :—**

1. Part 'A' may be attempted in first 6 pages of Answer Sheet.  
भाग 'क' के सभी उत्तर, उत्तर-पुस्तिका के प्रथम छः पृष्ठों में ही करने हैं।
2. Part 'B' in rest of the Sheets of Answer Sheet.  
भाग 'ख' के उत्तर, उत्तर-पुस्तिका के अगले शेष पृष्ठों में लिखिये।
3. Answers may be given in English or Hindi.  
प्रश्नों के उत्तर अंग्रेजी अथवा हिन्दी में दीजिये।

## PART - A

## 1. Attempt any 10 questions:

(10 × 2 = 20)

- (i) Define Dead-zone nonlinearity.
- (ii) Write Vander Pol's differential equation.
- (iii) Define continuous-time system.
- (iv) What are LTI systems?
- (v) How does pole and zero decides that the system is stable or not?
- (vi) Define transfer function.
- (vii) What are SISO systems?
- (viii) Define controllability.
- (ix) Explain self-tuning control system.
- (x) What is lag-lead compensation?
- (xi) What is observability?
- (xii) State initial value theorem.
- (xiii) Define stability.

## 2. Attempt any 5 questions:

(5 × 4 = 20)

- (i) Explain important parameters of stepper motor.
- (ii) Define series and feedback compensation.
- (iii) Explain the sampled-data control system with block diagram.
- (iv) Explain the relationship between the s-domain and z-domain.

- (v) Find the z-transform of  $\sinh \beta k$  and  $\cosh \beta k$ .
- (vi) Derive state transition matrix with suitable example.
- (vii) Explain briefly the perturbation technique for used for judging the stability of limit cycle.
- (viii) Explain the sinusoidal response of a relay nonlinearity with dead-zone and hysteresis.

## PART- B

(3 × 20 = 60)

Attempt any 3 questions:

3. (i) Explain Model Reference Adaptive Controller.
- (ii) Explain the duality between controllability and observability.
4. Consider the Plant:

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

Prove that the system is unstable but controllable.

5. (i) Explain Permanent-Magnet Stepper Motor.
- (ii) Find the z-Transform of the discrete ramp function  $g(k) = k; k > 0$   
 $= 0; k < 0$ .
6. For the sampled-data system (shown in the figure 1 below), find the response to unit step input.

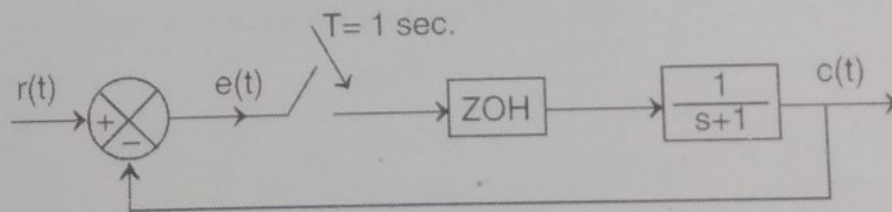


Fig. 1

7. Write short note on any two:
- (i) Liapunov stability analysis
- (ii) State transition matrix
- (iii) Interfacing of stepper motor to microprocessor
- (iv) Asymptotic stability and instability.