Dr. Raseswari Pradhan

Total Pages—5

(Set-K)

B.Tech-6th

Control System Engg.-II

Full Marks : 70

Time : 3 hours

Answer any **six** questions including **Q.No.1** which is compulsory

The figures in the right-hand margin indicate marks

1. Answer the following questions : 2×10

(*a*) What is State Transition Matrix and explain three of its properties ?

(*b*) Give a state equation of a system. Convert it into a Transfer function model.

(*c*) What are the different State-space representations ? Give the mathematical equations only.

(*d*) Determine the definiteness of the quadratic form

$$V(x) = x_1^2 + 4x_1x_2 + 5x_2^2 + 2x_2x_3 + x_3^2$$

positive semidefinite.

(*e*) What is MIT rule of parameter adjustment mechanism used in model reference adaptive controller ?

(*f*) How to test the controllability and observability of a LTI system ?

(*g*) How the derivative and integrals in continuous Time System are approximated in Discrete Time System.

(*h*) What is the function of a hold device ? What is the transfer function of a ZOH device ?

(*i*) What are the phenomena exhibited by a non-linear system that are not found in a linear system ? 1+1

(*j*) What is the stability criterion in Discrete Time System ?

2. (*a*) Find

$$x(kT) \text{ if } X(z) = \frac{10z}{(z-1)(z-2)}$$

Using

(*i*) Long Division method

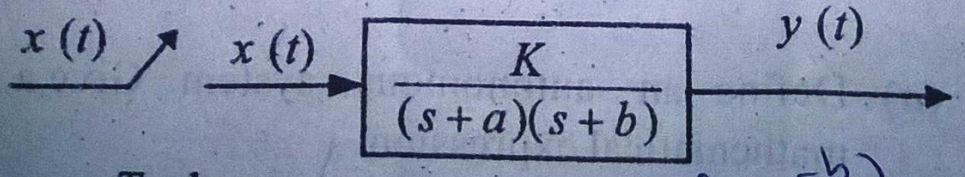
(*ii*) Partial Fraction Expansion method

(*iii*) Inversion integral method. 5

(*b*) Explain the different Signal Processing involved in a typical Digital Control System. 5

3. (*a*) Obtain a state-space model of an armature controlled dc motor, choosing the angular position (θ), angular velocity ($\dot{\theta}$) and armature current (i_a) as the state variables. 5

(*b*) Obtain the pulse Transfer Function of the system shown in figure below : 5



$T = 1\text{sec}$

$$G(z) = \left(\frac{K}{b-a}\right) \frac{z\left(e^{-a} - e^{-b}\right)}{\left(z-e^{-a}\right)\left(z-e^{-b}\right)}$$

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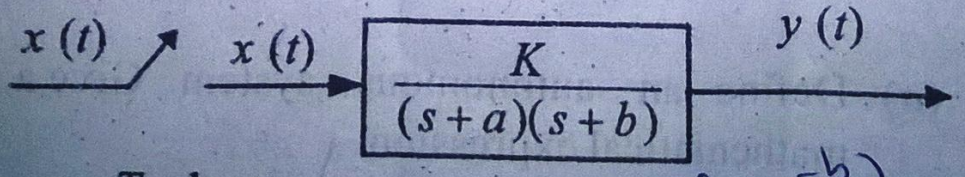

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(*c*) What is a limit cycle ? 2

(*d*) Derive the Describe Function for a Dead-zone non-linearity.

7. Obtain a discrete-time state space representation of the following continuous time system

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u.$$

Consider $T = 1$ sec

Derive the formula used. 10

8. (*a*) Explain the following : 5

(*i*) Limit cycles

(*ii*) Jump Response

(*b*) What is the PID control law in continuous time system ? Using backward difference and trapezoidal integration approximations for derivative and integrations in continuous time system derive the control law in discrete time system. 5
