Total No. of Questions : 8]

SEAT No. :

PC-2392

[Total No. of Pages : 2

[6354]-509
B.E. (Electrical)
ADVANCED CONTROL SYSTEM
(2019 Pattern) (Semester - VII) (403142)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) ***Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.***
2) ***Figures to the right indicate full marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Assume suitable data, if necessary.***

Q1) a) Define the terms : **[10]**

i) State

ii) State variables

iii) State vector

iv) State space

v) State equation

b) Define state transition matrix and its properties. Also derive the state transition matrix by Laplace transform. **[8]**

OR

Q2) a) For a given system $A = \begin{pmatrix} -2 & 3 \\ 0 & 3 \end{pmatrix}$, $x(0) = [10]^T$ Obtain STM & find its solution. **[8]**

b) Consider the system defined by $\frac{Y(S)}{U(S)} = \frac{3x^2 - 11s}{s^3 - 6s^2 + 11s - 6}$ Determine State space representation in Controllable canonical form & Observable canonical form. **[10]**

P.T.O.

Q3) a) State and Explain Gilbert's tests for controllability and observability with suitable example. **[8]**

b) A system is described by $x(t) = \begin{pmatrix} 0 & 1 \\ -12 & -7 \end{pmatrix} x + \begin{pmatrix} 1 \\ 1 \end{pmatrix} u \quad y(t) = [1 \ -1]\, x$,

Verify its Duality theorem. **[9]**

OR

Q4) a) Explain the concept of State observers? Design a full order state observer with diagram. **[8]**

b) Consider system defined by $x(t) = \begin{pmatrix} 0 & 1 \\ -0.16 & -1 \end{pmatrix} x + \begin{pmatrix} 0 \\ 1 \end{pmatrix} u$ Determine the suitable state feedback gain matrix K such that system will have the close loop poles at S1 = 0.5 + j0.5, S2 = 0.5 –j0.5. **[9]**

Q5) a) Show how mapping of left half of S-plane is done into the Z plane with stable and unstable Region with proper diagrams. **[8]**

b) Define sampling & reconstruction process and Explain the Shannon's Sampling theorem. **[10]**

OR

Q6) a) Explain in detail basic building blocks of discrete time control system and State advantages of digital control system. **[8]**

b) Determine stability of system using Bilinear Transformation whose characteristic polynomial is $Z^3 - 1.3Z^2 - 0.08Z + 0.24 = 0$. **[10]**

Q7) a) Describe a self-tuning regulator with suitable block-diagram and List out the properties of sliding mode control. **[8]**

b) Explain in details the terms, variable structure control, sliding phase, reaching phase and chattering with suitable diagram. **[9]**

OR

Q8) a) If the system is given by $\dot{x} = Ax + Bu$ and sliding surface is given by $\dot{s} = Sx$, prove that the closed loop system obtained by applying the equivalent control is $\dot{x} = (I_n - \mathrm{B}(SB)^{-1}S)Ax$. **[8]**

b) Explain the concept of sliding mode control and Draw block diagram of Model Reference Adaptive Control scheme and explain it. **[9]**

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