Code No: 117CG

R13

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, March - 2017
DIGITAL CONTROL SYSTEMS
(Common to EEE, EIE)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

Part- A (25 Marks)

1.a) What is a pulse transfer function? [2]
b) Discuss in brief the mapping between s-plane and z-plane. [3]
c) Write down the properties of state transition matrix. [2]
d) State the conditions for the system to be state controllable and observable. [3]
e) What is bilinear transformation? [2]
f) What are the advantages of dead beat control? [3]
g) What are lag – lead compensators. [2]
h) What are primary strips? [3]
i) What are the necessary and sufficient conditions for designing a state feedback controller through pole placement? [2]
j) Write the Ackermann's formula. [3]

Part-B (50 Marks)

2.a) Given the Z-transforms

$$X(z) = \frac{z^{-1}}{(1 - z^{-1})(1 + 1.3z^{-1} + 0.4z^{-2})}$$

Determine the initial and final values of x (k). Also find x (k), in a closed form.
b) State and explain the sampling theorem. [5+5]

OR

3.a) State the limitations of Z- Transforms.
b) Obtain the z-transform of
i) $f(t) = t^2$ ii) $f(t) = e^{-at}\sin wt$ [5+5]

4.a) Explain the concept of controllability and observability of discrete time control system.
b) Derive necessary conditions to be satisfied for system to be controllable. [5+5]

OR

5.a) The pulse transfer function of digital control system is given by

$$G(z) = \frac{5z}{z^2 + 2z + 2}$$

Obtain a state space representation for the system.
b) Obtain the state transition matrix for the above system. [5+5]

6.a) Using Jury's stability criterion find the range of K, for which the characteristic equation: $Z^3 + Kz^2 + 1.5\,Kz - (K+1) = 0$ is closed loop stable.

b) Write short notes on complementary strips. [6+4]

OR

7.a) Explain in brief the Routh Stability Criterion.

b) Explain the stability analysis of the closed loop system. [5+5]

8.a) Explain the design procedure of digital PID controllers.

b) Explain assumption considered to design digital controllers through deadbeat response method. [5+5]

OR

9. Consider the single input digital control system

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

Determine the state feedback matrix K such that the state feedback $\mu(k) = -K X(k)$, places the closed loop system poles at $0.3 \pm j0.3$. [10]

10.a) Draw the block diagram for digital system with a reduced order observer.

b) Explain how reduced order observation is different from minimum order observation. [5+5]

OR

11. State the salient steps involved in the design of state feedback controller through pole placement with a suitable example. [10]

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