

Code No: 157BE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**B. Tech IV Year I Semester Examinations, January/February - 2023****DIGITAL CONTROL SYSTEMS****(Electrical and Electronics Engineering)****Time: 3 Hours****Max. Marks: 75****Note:** i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A**(25 Marks)**

- 1.a) Define sampling. [2]
b) What are the features of discrete time system? [3]
c) What is z-transform? [2]
d) What are the important regions of z-plane? [3]
e) Define state space of a system. [2]
f) What is the significance of controllability? [3]
g) What is PID controller? [2]
h) What is the use of observer? [3]
i) What is fast output sampling? [2]
j) Explain the significance of discrete output feed control. [3]

PART – B**(50 Marks)**

- 2.a) How a continuous system is represented in discrete form? Explain. [5+5]
b) Explain the effects of sampling and quantization in detail. [5+5]
- OR**
- 3.a) Explain the basics of digital control system in detail. [5+5]
b) How to choose sampling frequency? Explain. [5+5]
- 4.a) How to obtain pulse transfer function of a closed loop system? Give an example. [5+5]
b) Obtain the z transform of the function. $10 + e^{2t} + \sin 3t$ [5+5]
- OR**
- 5.a) How stability is analyzed using bilinear transformation? Explain. [5+5]
b) Consider the discrete time control system defined by
$$\frac{Y(z)}{R(z)} = \frac{2 + 2z^{-1} + z^{-2}}{1 + z^{-1} + z^{-2}}$$
Determine the unit step response. [5+5]

- 6.a) Explain the effect of pole zero cancellation on observability.
 b) Check whether the following system is observable or not [5+5]

$$\begin{aligned}x(k+1) &= Gx(k) + Hu(k) \\ y(k) &= Cx(k) \\ G &= \begin{bmatrix} -1 & 3 \\ 1 & -1 \end{bmatrix}, H = \begin{bmatrix} -1 \\ 3 \end{bmatrix} \text{ and } C = [-1 \quad 1]\end{aligned}$$

OR

- 7.a) What is Lyapunov stability? Explain in detail
 b) Obtain the state equation and output equation for the system defined by [5+5]

$$\frac{Y(z)}{U(z)} = \frac{2z^{-1} + 7z^{-2}}{3 + z^{-1} + z^{-2}}$$

8. Consider the system $x(k+1) = Gx(k) + Hu(k)$ where
 $G = \begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix}, H = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$
 Determine a suitable state feedback gain matrix K such that the system will have the closed loop poles at $z = 0.5 + j0.5, z = 0.5 - j0.5$ [10]

OR

9. How to design discrete observer for LTI systems? Explain. [10]
 10.a) What are the basic components of a feedback control system? Explain.
 b) What are the applications of fast output sampling feedback controller? Explain. [5+5]
OR
 11. Explain in detail about the design of periodic output feedback controller. [10]

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