Roll No…….. **Total No. of Printed Pages: 1**
Total No. of Questions: [09]

B.Tech Electrical Engineering (Semester –6th)
NON-LINEAR & DIGITAL CONTROL SYSTEM
Subject Code: BELED1-612
Paper ID: [18111532]

Time: 03 Hours **Maximum Marks: 60**
Instruction for candidates:
1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(2 marks each)**

Q1. Attempt the following:
a. What is a Sample and Hold Circuit
b. Define the term Controllability?
c. Why is the Choice of Sampling Frequency Important in Discrete Systems
d. What is the Main Difference Between Linear and Nonlinear Control Systems
e. What is the Regulator Problem in Optimal Control
f. What is the Fast Output Sampling (FOS) Technique in Discrete Output Feedback Control
g. What is the Role of a Discrete PID Controller in Control Systems
h. What is state variable model?
i. What Are the Key Concepts in State Space Analysis for Discrete Systems
j. What are singular point?

Section – B **(5 marks each)**

Q2. What is the Zero-Order Hold (ZOH) equivalent in digital control systems?
Q3. Explain the Jury stability test and its significance in control system analysis. Provide the steps involved in the Jury stability test and illustrate with an example if possible.
Q4. Explain the concept of Fast Output Sampling (FOS) in discrete control. How does it enhance control performance, and what are the steps involved in designing a Fast Output Sampling controller
Q5. Explain the step-by-step design process for a discrete Proportional-Integral-Derivative (PID) controller
Q6. Explain the concept of Lyapunov Stability in control systems. What is the role of Lyapunov functions, and how are they employed in analyzing the stability of dynamical systems?

Section – C **(10 marks each)**

Q7. Define the following a) Discrete Compensator b) PID Controller c) Inverse Z Transform.
Q8. Analyse the stability behavior of the following system using the variable gradient method:

$$\dot{x}_1 = -ax_1 \quad \dot{x}_2 = bx_2 + x_1 x_2^2$$

Q9. What is the mathematical model that represents the operation of a Sample and Hold circuit in discrete-time systems?