



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE-R19

III Year – II SEMESTER				
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DIGITAL CONTROL SYSTEMS				

Preamble:

In recent years digital controllers have become popular due to their capability of accurately performing complex computations at high speeds and versatility in leading nonlinear control systems. In this context, this course focuses on the analysis and design of digital control systems.

Learning objectives:

- To understand the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analog type.
- The theory of z-transformations and application for the mathematical analysis of digital control systems.
- To represent the discrete-time systems in state-space model and evaluation of state transition matrix, the design of state feedback control by “the pole placement method.”, design of state observers.
- To examine the stability of the system using different tests.
- To study the conventional method of analyzing digital control systems in the w-plane.

UNIT – I:

Introduction and signal processing

Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Continuous and Discrete Time Signals – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT-II:

z-transformations

z-Transforms – Theorems – Finding inverse z-transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT-III:

State space analysis and the concepts of Controllability and observability

State space representation of discrete time systems – Solving Discrete Time state space equations – State transition matrix and its properties – Discretization of continuous time state equations – Concepts of controllability and observability – Tests(without proof).



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State Feedback Controllers and State Observers

Design of state feedback controller through pole placement – Necessary and sufficient conditions
 – Ackerman's formula – Design of state observers (Full Order and Reduced Order).

UNIT – IV:

Stability analysis

Mapping between the s-Plane and the z-Plane – Primary strips and Complementary strips –
 Stability criterion – Modified Routh's stability criterion and Jury's stability test.

UNIT – V:

Design of discrete-time control systems by conventional methods

Transient and steady state specifications – Design using frequency response in the w-plane for
 lag and lead compensators – Root locus technique in the z-plane.

Learning outcomes:

After the completion of the course the student should be able to:

- learn the advantages of discrete time control systems and the “know how” of various associated accessories.
- understand z-transformations and their role in the mathematical analysis of different systems (like Laplace transforms in analog systems).
- learn the stability criterion for digital systems and methods adopted for testing the same are explained.
- understand the conventional and state space methods of design are also introduced.

Text Book:

1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M.Gopal, TMH, 4th Edition.

Reference Books:

1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.