

**Maulana Abul Kalam Azad University of Technology, West Bengal**

(Formerly West Bengal University of Technology)

**Syllabus for B. Tech in Electrical Engineering**

(Applicable from the academic session 2018-2019)

<b>Name of the course</b>	<b>DIGITAL CONTROL SYSTEM</b>
<b>Course Code: PE-EE-601A</b>	<b>Semester: 6th</b>
<b>Duration: 6 months</b>	<b>Maximum Marks: 100</b>
<b>Teaching Scheme</b>	<b>Examination Scheme</b>
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Credit Points: 3	Attendance: 05 Marks
	End Semester Exam: 70 Marks

**Objective:**

1. To understand the principle of sampling and reconstruction of signals.
2. To find Z-transform and inverse Z-transform of systems.
3. To carry out the analysis and design of digital control systems
4. To design compensators for digital control system to achieve desired specifications.
5. To represent digital control systems using state space models.
6. To analyze the effect sampling on stability, controllability and observability.
7. To design digital controllers for industrial applications.
8. To solve numerical problems on the topics studied.

**Pre-Requisite**

Unit	Content	Hrs	Marks
1	<b>Sampling and reconstruction:</b> Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.	03	
2	<b>Z-transform:</b> Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms	05	
3	<b>Z- Plane analysis of discrete-time control system:</b> Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.	05	
4	<b>State space analysis:</b> State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations.	06	
5	<b>Controllability and observability:</b> Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function	04	
6	<b>Stability analysis:</b> Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of	05	

	closed loop systems in the Z-Plane. Jury stability test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.		
7.	<b>Design of discrete time control system by conventional methods:</b> Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.	06	
8.	<b>State feedback controllers and observers:</b> Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.	05	

#### **Text book:**

1. Digital Control and State Variable Methods , M. Gopal, TMH Publishers
2. Discrete-time Control Systems, K. Ogata, Pearson Education,
3. Digital Control Systems, B.C. Kuo, Wiley Publications.
4. Control System Engineering, I.J. Nagrath, M. Gopal, New age International.

#### **Reference books**

1. Digital control of dynamic systems, Gene F. Franklin, J. David Powell, and Michael Workman 3rd ed, 1998, Addison-Wesley.
2. Digital Control Systems, design, identification and implementation, Landau, Ioan Doré, Zito, Gianluca, Springer-Verlag London.

#### **Course Outcome:**

After completion of this course, the learners will be able to

1. explain the principle of sampling and reconstruction of analog signal.
2. perform Z-transformation and inverse Z-transformation of systems.
3. analyse and design digital control systems.
4. design compensators for digital control system to achieve desired specifications.
5. represent digital control systems using state space models.
6. analyze the effect sampling on stability, controllability and observability.

#### **Special Remarks (if any)**

The above-mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.