NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B. Tech in Electronics and Instrumentation Engineering
Course Code:	2EI702
Course Title:	Nonlinear and Digital Control
Course Type:	([√] **Core/[]** Value Added Course/[] Departmental Elective/ [] Institute Elective/[]University Elective/[]Any other)
Year of introduction:	2022-2023

Credit Scheme

L	T	Practical component				C
		LPW	PW	W	S	
2	-	2	-	-	-	3

Course Learning Outcomes (CLO):

At the end of the course, students will be able to –

1.interpret the basics of Nonlinear control system
2.illustrate the basics of sampled data control system
3.analyze the nonlinear and discrete time system
4.design controller and observer for discrete time system

Syllabus: **Total Teaching hours: 30**

Unit	Syllabus	Teaching hours
Unit-I	**Introduction to Nonlinear Control System** Nonlinear system elements, Continuous and discontinuous nonlinearities, Behavior of nonlinear control systems, State space representation of nonlinear system.	03
Unit-II	**Stability Analysis** Introduction to Phase plane analysis, concept of equilibrium point and related stability, Linearization techniques, Stability using Lyapunov method, Feedback Linearization method, related examples.	06
Unit-III	**Digital Control System: Mathematical Modeling** Introduction to Digital control of continuous time system, Overview of sampled data control system. Discrete-time system and Z-Transformation, Modified z-transform, Mapping od s-plane to z-plane, State space description of dynamic system, related examples.	07

Unit-IV	**Digital Control System: Analysis** Computation of the solution of discrete time state equations, state space based time response analysis for various inputs, Jury's stability test for the sampled data control system, stability analysis of discrete time system	07
Unit-V	**Digital Control System: Design** Discrete time observer and controller, related examples, Separation Principle for discrete time state model based system	07

Self-Study: The self study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self study contents.

Laboratory Work: Laboratory Work will consist of minimum 10 experiments based on the above syllabus.

Suggested List of Experiments:

1. Study of various nonlinear systems
2. Analyze the behavior of the nonlinear system in presence of time varying input
3. Analysis of nonlinear system using linearization techniques
4. Analysis of nonlinear system using Lyapunov's method
5. Develop the mathematical modeling of the discrete time system in the state space domain
6. Analyze sampled data control system
7. Perform the stability analysis of the sampled data system
8. Analyze the discrete time control system
9. Perform stability analysis of discrete time control system
10. Design a state feedback controller for the discrete time system
11. Design a state observer for the discrete time system
12. Design a state feedback controller using the separation principle

Suggested Readings/ References:

1. M. Gopal, Digital control and state variable methods, New Age International Publication
2. Hasan Khalil, Nonlinear Control, Pearson Education
3. Hasan Khalil, Nonlinear Systems, Pearson Education
4. I.J. Nagrath and M. Gopal, Control System Engineering, New Age International Publication

Suggested Case List: --

L= Lecture, T=Tutorial, P= Practical, C= Credit

w.e.f. academic year 2024-25 and onwards.