COURSE TITLE	**ADVANCE CONTROL SYSTEM**
COURSE CODE	**01EE0719**
COURSE CREDITS	**3**

Objective:

1 To provide a strong foundation on advanced control methods for modelling and stability analysis of linear and nonlinear systems. Familiarize with the concept of design of feedback controllers and observers.

Course Outcomes: After completion of this course, student will be able to:

1 Carry out discretization of continuous time system.

2 Develop state-space models for continuous–time and discrete–time systems.

3 Analyze the performance of linear and nonlinear systems using state variable approach.

4 Design state feedback controller for a given system.

Pre-requisite of course: Control System Engineering

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**Discretization of continuous systems** Introduction, sampling theorem, z transform, zero order hold, convert transfer function, continuous to discrete domain, mapping between s and z domain, stability criteria in z- domain, Effect of sample time on systems stability, Root locus for discrete time systems stability	5
2	**State Space Representation of Systems** Introduction to state space and state model concepts- State equation of linear continuous time systems, matrix representation- features- Examples of electrical circuits and dc servomotors, Phase variable forms of state representation, Diagonal Canonical forms- Similarity transformations to diagonal canonical form	6

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Contents : Unit	Topics	Contact Hours
3	**State Space Analysis** State transition matrix- Properties of state transition matrix, Computation of state transition matrix using Laplace transform and Cayley Hamilton method, Derivation of transfer functions from state equations, Solution of time invariant systems: Solution of time response of autonomous systems and forced systems, State space analysis of Discrete Time control systems: Phase variable form and Diagonal canonical form representations, Pulse transfer function from state matrix, Computation of State Transition Matrix	9
4	**State Feedback Controller Design** Controllability & observability, Kalman's, Gilbert's and PBH tests.- Duality principle State feedback controller design, State feed-back design via pole placement technique State observers for LTI systems- types, Design of full order observer	6
5	**Nonlinear systems** Introduction - characteristics of nonlinear systems, Types of nonlinearities, Analysis through harmonic linearization , Determination of describing function of nonlinearities, application of describing function for stability analysis of autonomous system with single nonlinearity	8
6	**Phase Plane Analysis** Concepts- Construction of phase trajectories for nonlinear systems and linear systems with static nonlinearities , Singular points – Classification of singular points, Definition of stability- asymptotic stability and instability, Liapunov methods to stability of linear and nonlinear, continuous time systems	8
Total Hours		**42**

Textbook :

1 Control System Engineering, 5/e, Nagarath I. J. and Gopal M., New Age Publishers, 2007

2 Modern Control Engineering, 5/e, Ogata K., Prentice Hall of India, 2010

References:

1 Modern control system theory, Modern control system theory, Gopal M., New Age International, 1993

2 Analysis and Synthesis of Sampled Data Systems, Analysis and Synthesis of Sampled Data Systems, Kuo B.C, Prentice Hall Publications, 2012

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

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Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

1 The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs, etc

2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and classroom

3 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, and Virtual Laboratory

Supplementary Resources:

1 https://archive.nptel.ac.in/courses/108/103/108103007/

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