Course Code	Course Title	L-P-T	Credits
UMAT0O0026T	Dynamical System and Control	3-0-1	4

Objectives: The aim of this course is to introduce the students to linear and non-linear dynamical systems, control systems, observability, etc. The course may be useful for PhD students also (those who have not studied in UG/PG Level). After pursuing this course, the student shall be able to:

CO 01	Understand the fundamentals of linear and nonlinear systems.
CO 02	Learn the autonomous and nonautonomous system.
CO 03	Analysis of stability theory using phase portraits.
CO 04	Understand the controllability and observability in control theory.
CO 05	Analysis of different type of observer and optimality in control theory.

Course Content

UNIT-I

Introduction of linear and nonlinear dynamical system, Formulation of physical systems, Existence and uniqueness theorems, Linear systems, Solution of linear systems, Fundamental Matrix-I.

UNIT-II

Fundamental Matrix-II, Fundamental matrices for non- autonomous systems, Solution of non-homogeneous systems, Stability of systems: Equilibrium points, Stability of linear autonomous systems, Stability of weakly non-linear systems, Stability of non-linear systems using linearization.

UNIT-III

Properties of phase portrait, Properties of orbits, Phase portrait: Types of critical points, Phase portrait of linear differential equations-I, Phase portrait of linear differential equations, Poincare Bendixson Theorem, Limit cycle, Lyapunov stability.

UNIT-IV

Introduction to Control Systems, Controllability of Autonomous Systems, Controllability of Non-autonomous Systems, Observability, Results on Controllability and Observability, Companion Form, Feedback Control.

UNIT-V

State Observer, Stabilizability, Introduction to Discrete Systems, Lyapunov Stability Theory, Optimal Control, Optimal Control for Discrete Systems, Controllability of Discrete Systems, Observability of Discrete Systems, Stability for Discrete Systems, Relation between Continuous and Discrete Systems.

Reference Books:

1. Nader Jalili and Nicholas W. Candelino, Dynamic Systems and Control Engineering, by, Cambridge University Press.
2. Braun, M. "Differential Equations and Their Applications", 4th Ed., Springer 2011.
3. Stephen Barnett, Introduction to Mathematical Control Theory, Oxford University Press, 1990
4. D. Subbaram Naidu, Optimal Control Systems, CRC Press, 2003
5. Deo, S.G., Lakshmikantham, V., and Raghvendra, V., "Textbook of Ordinary Differential Equations", 2nd Ed., Tata McGraw Hill 2010.
6. M. Gopal, Modern Control System Theory, John Wiley & Sons Ltd., 1994.
7. Simmons G.F., "Ordinary Differential Equations with Applications", Tata McGraw Hill 2003.

Shalaksh

Kamlesh Kumar