Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NMCD544	Advanced Ordinary Differential Equations	3	0	0	3

Prerequisite
Basic Theory of Ordinary Differential Equations, Linear Algebra and Real Analysis

Course Objective
The objective is to teach the advanced theory and applications of system of differential equations with linear and nonlinear features. The methods of solutions and the behavior of solutions play a significant role in understanding dynamical systems which arise in biological, physical and engineering sciences. These things will be explained to students.

Learning Outcomes
Upon successful completion of this course, student can solve system of differential equations confidently and understand the stability behavior of solutions by applying several methods. Students can apply the methods and analysis to real-world problems.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Existence, uniqueness and continuation of solutions for system of differential equations.	8	Student will understand existence and uniqueness theory which uses certain criteria.
2	Properties of linear homogeneous systems, Inhomogeneous systems, Behaviour of solutions of n-th order linear homogeneous systems.	9	Student will learn the fundamental properties of homogeneous and nonhomogeneous linear systems also the asymptotic behavior of linear systems with constant and variable coefficients.
3	Stability of linear systems: Continuous dependence and stability properties of solutions, Linear systems, Two-dimensional systems.	8	Student will understand stability behavior of solutions. In this unit, student will learn concepts of Liapunov's stability and theorems with worked examples to distinguish various types of stability.
4	Stability by Liapunov direct method for autonomous and non-autonomous systems.	8	Student will learn the application of Liapunov's direct method to stability theory and sufficient conditions for stability and instability of autonomous and non-autonomous systems.
5	Bifurcations: Examples of simple bifurcations, The fold and cusp, Types of bifurcations, Hopf bifurcations.	9	Student will understand systems of differential equations depending on a parameter. Using the Bifurcation theory, student will understand the role of parameter values at which the global phase portrait of dynamical system change its qualitative structure.
	Total	**42**	

Text Books

1. S. Ahmad, M. R. M. Rao, Theory of Ordinary Differential Equations with Applications to Biology & Engineering, Affiliated East-West Press Private Limited, 1999.
2. R. Grimshaw. Nonlinear Ordinary Differential Equations (1st ed.), CRC Press 1991.

Reference Books

1. D.W. Jordan, P. Smith, Nonlinear Ordinary Differential Equations: An Introduction for Scientists and Engineers. Fourth Ed., Oxford Uni. Press, 2009.
2. L. Perko, Differential Equations and Dynamical Systems, Springer, 2001.