

Course Name	: Ordinary Differential Equations
Course Number	: MA-513
Credit	: 3-1-0-4
Prerequisites	: NA
Students intended for	: M.Sc. /M.S./Ph.D./B.Tech 3 <sup>rd</sup> and 4 <sup>th</sup> year
Elective or core	: Core for M.Sc. in applied Mathematics and Elective for other discipline.
Semester	: Odd/Even

Preamble:

Differential equations are very important field in terms of applications as well as theory. This course introduces techniques for solving ordinary differential equations. First unit is basically on methods of solving. The next section “existence and uniqueness” is important especially when there is no way to solve a given differential equations. Other two units are focused on systems of differential equation and second order differential equations, which arises while modeling several physical and natural processes.

Course outline:

The intended outcomes are:

- Revising the basic methods of solving an ordinary differential equation
- Check if the given system is well defined
- Expressing system in matrix form and express solution in the form of matrix

Module:

General Overview: Solutions methods: General solution methods, Power Series methods with properties of Bessel functions and Legendre polynomials. [8 Hours]

Existence and Uniqueness: Existence and Uniqueness of Initial Value Problems: Picard's and Peano's Theorems, Gronwall's inequality, continuation of solutions and maximal interval of existence, continuous dependence. [11 Hours]

Systems of Differential Equations: Algebraic properties of solutions of linear systems, The eigenvalue–eigenvector method of finding solutions, Complex eigenvalues, Equal eigenvalues, Fundamental matrix solutions, Wronskian, Matrix exponential, Nonhomogeneous equations, Variation of parameters, Stability theory for linear and nonlinear systems, Lyapunov function. [16 Hours]

Boundary value problems: Green's function, Sturm comparison theorems and oscillations, eigenvalue problems. [7 Hours]

**Texts Books:**

1. G.F. Simmons and S.G. Krantz, Differential Equations: Theory, technique and practice, Tata McGraw-Hill, 2007.
2. V. Arnold, Ordinary Differential Equations, MIT Press, 1978.
3. Coddington, E. A. and Levinson, N., Theory of Ordinary Differential Equations, Krieger Publishing Co, 1984.

**Reference Books:**

1. Ahmad, S. Rao, M.R.M., Theory of ordinary differential equations with applications in biology and engineering, EWP publication, 1999.
2. L. Perko, Differential Equations and Dynamical Systems, Texts in Applied Mathematics, Vol. 7, 2nd ed., Springer Verlag, New York, 1998.
3. Devaney, R., Hirsch, M. W. and Smale, S., Differential Equations, Dynamical Systems, and an Introduction to Chaos (2nd Edition), Academic Press, 2003.
4. Birkhoff, G. and Rota, G.-C., Ordinary Differential Equations, wiley, 1989
5. R.P. Agarwal and D. O'Regan, An Introduction to Ordinary Differential Equations, Springer- Verlag, 2008.