Course No	Course Name	L-T-P-Credits
MA 405	**Ordinary Differential Equations**	**3-1-0: 4**

Prerequisite: nil

Course Objectives: The objective of this course is to present several tools and techniques for solving ordinary differential equations (ODEs). It also discusses some fundamental theories which will help in understanding the qualitative properties of the solutions without solving the ODEs explicitly.

Course Outcomes: After successful completion of the course, students will be able to:

1. Verify the existence and uniqueness of solutions for ODEs of first order.
2. Construct linearly independent solutions of linear homogeneous ODEs and relize the idea of Wronskian and related theorems.
3. Solve several linear ODEs of second and higher order by operator method, variation of parameter method and series solution method.
4. Gain knowledge on the distribution of zeros for solutions (or linearly independent solutions) of second order liner homogeneous ODEs.
5. Solve system of linear OEDs by eigenvalue method and matrix exponential method.
6. Determine fixed points of autonomous equations and examine their stability nature.
7. Solve boundary value problems and understand the related theory.

SYLLABUS

Module	Contents	Hours
I	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.	8
II	Second and higher order linear equations: Euler-Cauchy equations, method of variation of parameters, Sturm comparison and Sturm separation theorems, Power Series and Frobenius series solution methods, Bessel functions and Legendré polynomials.	9
III	System of linear differential equations: fundamental solutions, Wronskian, matrix exponential solution, behaviour of solutions.	6
IV	Two dimensional autonomous systems and phase space analysis: critical points, proper and improper nodes, spiral points and saddle points. Asymptotic behavior: stability (linearized stability and Lyapunov methods).	6
V	Boundary Value Problems for second order equations: Green's function, Sturm-Liouville problems.	7

Essential Readings:

1. S. L. Ross, “Differential Equations”, Wiley India, 3rd edition, 2007.
2. G. F. Simmons and S. G. Krantz, “Differential Equations: Theory, Technique, and Practice”, McGraw Hill, 1st edition, 2017.

Supplementary Readings:

1. W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley, 9th edition, 2015.
2. L. Perko, "Differential Equations and Dynamical Systems", Springer Verlag, 3rd edition, 2001.
3. E. A. Coddington and N. Levinson, "Theory of Ordinary Differential Equations", McGraw Hill, 1st edition, 2017.