

Certificate Course

Course Name: Differential Equations and its Applications

Eligibility Criteria for Admission: Passed 10+2 or equivalent examination with Mathematics in any stream having minimum 50% marks or equivalent grade in aggregate.

Course Starting Date: **09.04.2024**

Detailed course Structure

Course Code	:	
Course Title	:	Differential Equations and its Applications
Number of Credits	:	3 (L: 2, T:1, P:0)
Course Category	:	Certificate Course

Course Objectives: The aim goal of this course is to learn the formation of ODE, the order and degree of ODE, known methods to solve first-order ODE, and initial and boundary value problems for first and second-order ODE. Test the ODE has the unique solution by Picard's existence and uniqueness theorem. Further, Wronskian of functions, reduction order, solution Linear equations with constant coefficients by the method of undetermined coefficients, Linear equations with variable coefficients by variation of parameters, and Euler-Cauchy equation. Further we learn Series solutions of ODE: ordinary points, power series solution, regular singular points, Frobenius method. Laplace transform definition, existence, first shifting theorem, second shifting theorem, convolution, and applications.

Course Content

Unit	Content	Hours
I	Basic concepts, Geometric meaning, Direction fields. 1 st order linear equations, homogeneous and non-homogeneous, Separation of variables, Exact Differential equations, integrating factors, Bernoulli Equation, Orthogonal trajectories, Existence Uniqueness: Picard's iteration, Autonomous Differential Equations and Population Dynamics. Nonlinear first order differential equations and their solutions.	10
II	2 nd and higher order Linear Differential equations: homogeneous and non-homogeneous equation with constant coefficients, Mass spring system, Wronskian, method of undetermined coefficients, operator method, variation of parameters method, Mechanical and Electrical Vibrations, Forced Periodic Vibrations, Euler's equation, Systems of first order differential equations, Trial solution method for linear system with constant coefficients and Eigen value technique. Particular	15

	solution.	
III	Laplace transforms generalities, Shifting theorems, Convolution theorem. Application to finding solution of initial value problem, integral equations and other applications, Step Functions, Differential Equations with Discontinuous Forcing Functions, Impulse Functions.	10

Texts/References

1. E. Kreyszig: *Advanced Engineering Mathematics*, 10th edition, Wiley, 2011.
2. William E. Boyce, Richard C. DiPrima, Douglas B. Meade: *Elementary Differential Equations and Boundary Value Problems*, 12th edition, Wiley, 2021.
3. T.M. Apostol: *Calculus*, Volume II, 2nd edition, Wiley, 1980.

Course Outcomes: Solution of some special classes of first-order ODEs; separable equations, homogeneous and exact ODE, integrating factors first order linear ODE, Bernoulli equation, finds the orthogonal and oblique trajectories. Students are also able to solve linear second-order ode with constant and variable coefficients and use Laplace transform to solve initial value problems. Furthermore, students are able to distinguish ordinary, regular singular and irregular points, and power series solutions, Frobenious series solutions.