2-Year Master's Program in Mathematics (NEP-2020)
ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Masters Mathematics (2nd Semester) Total Credits: 04
Course Code: MMTHCDE226 (15 hours per credit) Total Marks: 100
Continuous Assessment: Marks 30, Theory: Marks 70 Time Duration: 2½ hrs

Course Learning Outcomes (CLO's): After the completion of this course, students shall be able to:

- **CLO1**. Understand and apply fundamental theorems related to the existence, uniqueness, and continuation of solutions to ordinary differential equations.
- **CLO2.** Analyze linear systems of differential equations using fundamental matrices, variation of parameters, and apply Sturm-Liouville theory.
- **CLO3.** Solve and classify second-order partial differential equations using canonical forms, Laplace and Fourier transforms.
- **CLO4**. Apply separation of variables and eigenfunction methods to solve boundary value problems and wave equations in various coordinate systems.

UNIT -I

Existence of solutions, initial value problem, Arzela-Ascoli lemma, Cauchy Piano existence theorem, uniqueness of solutions with examples, Lipchitz condition and Gronwall inequality, method of successive approximation, Picard-Lindlof theorem, continuation of solutions, system of differential equations, dependence of solutions on initial conditions and parameters. Maximal and minimal solutions of the system of ordinary differential equations, Caratheodary theorem.

UNIT-II

Linear differential equations, linear homogeneous equations, linear system with constant coefficients, linear systems with periodic coefficients, fundamental matrix and its properties, non-homogeneous linear systems, variation of constant formula. Sturm-Liouville theory and Green function method with applications.

UNIT-III

Origin of second order partial differential equations, linear partial differential equations with constant coefficients, methods for solution of second order partial differential equations, classification of second order partial differential equations, canonical forms, Monge's method for the solution of non-linear partial differential equations. Laplace and Fourier transforms and their applications to partial differential equations.

UNIT-IV

Boundary value problems, Drichlet's and Neumann problems for a circle and sphere; solutions by separation of variables method, cylindrical coordinates and spherical polar coordinate system, maximum-minimum principle, uniqueness theorem, Derivation of wave equation, D' Alembert's solution of one dimensional wave equation, separation of variables method, periodic solutions; method of eigen-functions, Duhamel's principle for wave equation.

CLO-PLO Mapping Matrix (Strength version)

CLO ↓ PLO →	PLO 1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	Average CLO
MMTHCDE226.1	3	3	3	2	3	2	2	3	**2.62**
MMTHCDE226.2	3	3	2	3	3	3	2	2	**2.62**
MMTHCDE226.3	3	3	2	3	3	3	2	3	**2.75**
MMTHCDE226.4	3	3	3	3	3	3	2	2	**3**
Average PLO	**3**	**3**	**2.5**	**2.75**	**3**	**2.75**	**2**	**2.5**	**2.75**

<u>Recommended Books:</u>

1. D. Somasundaram, Ordinary Differential Equations, Narosa Publishers, New Delhi.
2. W.T.Reid, Ordinary Differential Equations.
3. E.A.Coddington and N.Levinson, Theory of Ordinary Differential Equations.
4. K. Sankara Rao, Introduction to Partial Differential Equations, PHI, 3rd Ed. 2011.
5. Robert C. Mc Owen, Partial Differential Equations-Methods and Applications, Pearson Education, Delhi, 2004.
6. L. C. Evans, Partial Differential Equations, GTM, AMS, 1998
7. H.T.H. Piaggio, Differential Equations, CBS Publishers and Distributors, New Delhi.
8. . John, Partial Differential Equations, 3rd ed., Narosa Publ. Co., New Delhi,1979.