[4] Walter Rudin, *Real and Complex Analysis*, 3rd Ed., McGraw Hill, 1986.

[5] M. Thamban Nair, *Functional Analysis* - A First Course, Prentice-Hall, 2002.

MTS 554	Partial Differential Equations	4 Credits (48 hours)

Prerequisite: Knowledge of syllabus prescribed for the course MTS 456 (Ordinary differential Equations).

Course Outcome: Students will have the knowledge and skills of solving partial differential equations with different techniques.

Course Outcome/Specific Outcome: At the end of the course Students will have the knowledge and skills to understand, explain in depth and apply in various situations the techniques to-

- Solve differential equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Pfaffian differential equations
- Find orthogonal trajectories of a system of curves on a surface
- Solve linear equations and Nonlinear equations of order one
- Study the Dirichlet problem for a rectangle, Neumann problems
- Solve Laplace equation in Cylindrical and Spherical coordinates.
- Solve diffusion equation in Cylindrical and spherical coordinates.
- Solve Initial value problem - D'Alembert's solution, Vibrating string
- Solve Boundary and initial value problems for two dimensional wave equation.

Unit I

Ordinary differential equations in more than two variables: Recapitulation of Methods of solution of $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$, Pfaffian differential forms and Pfaffian differential equations and solutions. Orthogonal trajectories of a system of curves on a surface.

First order partial differential equations: Origin of first order partial differential equations, The Cauchy problem for first order equations, Linear equations of first order, Integral surfaces passing through a given curve, Surfaces orthogonal to a given system of surfaces, Nonlinear equations of first order, Cauchy's method of characteristics, Charpit's method, Special types of first order equations.

(24 Hours)

Unit II

Higher Order Partial Differential Equations: Linear partial differential equations with constant coefficients, Classification of second order PDE, Canonical forms, Adjoint operators, Riemann's method.

Elliptic Differential Equations: Dirichlet problem for a rectangle, Neumann problem for a rectangle, interior and exterior Dirichlet problem for a circle, Interior Neumann problem for a circle. Solution of Laplace equation in Cylindrical and Spherical coordinates.

Parabolic Differential Equations: Occurrence of the diffusion equation, Elementary solutions of the diffusion equation, Dirac Delta function, Separation of variables, Solution of diffusion equation in Cylindrical and spherical coordinates.

Hyperbolic Differential Equations: Solution of one dimensional equation by canonical reduction, Initial value problem - D'Alembert's solution, Vibrating string - variable separation method, Forced vibrations, Boundary and initial value problems for two dimensional wave equation, Uniqueness of the solution for the wave equation, Duhamel's principle.

(24 Hours)

References

[1] Ian Sneddon, *Elements of Partial Differential Equations*, International student Ed., Mc-Graw Hill, 1957.

[2] K. Sankara Rao, *Introduction to Partial Differential Equations*, Prentice-Hall of India, 1995.

[3] F. John, *Partial Differential Equations*, Springer Verlag, New York, 1971.

[4] P. Garabedian, *Partial Differential Equations*, Wiley, New York, 1964.