DR. Anuj Kumar Sharma
Teaching Plan: DSC-15: Partial Differential Equations

Weeks 1 and 2: Basic concepts, classification, construction, and geometrical interpretation of first-order PDEs.

[1]: Chapter 2 (Sections 2.1 to 2.4).

Weeks 3 and 4: Method of characteristics and general solutions, Cauchy problem for a first-order PDE, Canonical forms of first-order linear equations; Method of separation of variables.

[1]: Chapter 2 (Sections 2.5 to 2.7).

Week 5: Charpit's method for solving non-linear PDEs.

[2]: Chapter 2 (Sections 9 [compatibility condition-based problems only], 10, and 11)

Weeks 6 and 7: Classification (hyperbolic, parabolic, and elliptic), reduction to canonical forms, and general solutions of second-order linear PDEs.

[1]: Chapter 4 (Sections 4.1 to 4.4).

Weeks 8 and 9: Higher order linear partial differential equations with constant coefficients.

[2]: Chapter 3 (Section 4).

Weeks 10 to 12: Mathematical models: The vibrating string, vibrating membrane, conduction of heat in solids, the gravitational potential, conservation laws and the Burgers equation, Traffic flow.

[1]: Chapter 3 (Sections 3.1, 3.2, 3.3, 3.5, 3.6, and 3.7).

[1]: Chapter 13 (Section 13.6). Note. For Traffic flow, Chapter 4 (Section 4.8, Problem 4.13.4 and 4.13.5) from the following book may be consulted. Banerjee, Sandip (2022). Mathematical Modeling: Models, Analysis and Applications (2nd ed.). CRC Press.

Weeks 13 to 15: Cauchy problem and wave equations: Solutions of homogeneous wave equations with initial boundary-value problems, and non-homogeneous boundary conditions, Cauchy problem for nonhomogeneous wave equations.

[1]: Chapter 5 (Sections 5.1, 5.3, 5.4, 5.5, and 5.7).

Essential Readings

1 Myint-U, Tyn & Debnath, Lokenath. (2007). Linear Partial Differential Equations for Scientists and Engineers (4th ed.). Birkhäuser. Indian Reprint.

2 Sneddon, Ian N. (2006). Elements of Partial Differential Equations, Dover Publications. Indian Reprint.

DR. Anuj Kumar Sharma
Teaching Plan: Discipline A-3: Differential Equations

Weeks 1 and 2: First order ordinary differential equations: Basic concepts and ideas, First order exact differential equations, Integrating factors and rules to find integrating factors.

[2]: Chapter 1 (Sections 1.1, and 1.2), Chapter 2 (Sections 2.1, 2.2, and 2.4 up to page 64).

Week 3: Linear equations and Bernoulli equations, Initial Value Problems, Applications of first order differential equations: Orthogonal trajectories and Rate Problems.

[2]: Chapter 2 (Sections 2.3), Chapter 3 (Section 3.1 up to page 74, and Section 3.3 up to page 94).

Weeks 4 and 5: Basic theory of higher order linear differential equations, Wronskian and its properties. [2]: Chapter 4 (Sections 4.1 up to page 115).

Weeks 6 and 7: Linear homogeneous equations with constant coefficients, Linear nonhomogeneous equations, Method of undetermined coefficients.

[2]: Chapter 4 (Section 4.1 from page 120 onwards, Sections 4.2, and 4.3).

Weeks 8 and 9: Method of variation of parameters (only second order), Two-point boundary value problems, Cauchy- Euler equations, Systems of linear differential equations.

[2]: Chapter 4 (Sections 4.4, and 4.5). [2]: Chapter 1 (Section 1.3 up to page 16). [2]: Chapter 7 (Sections 7.1, and 7.3).

Weeks 10 and 11: Partial differential equations: Basic concepts and definitions, Classification and construction of first-order partial differential equations, Method of characteristics and general solutions of first order partial differential equations.

[1]: Chapter 2 (Sections 2.1 to 2.3, and 2.5).

Weeks 12 and 13: Canonical forms and method of separation of variables for first-order partial differential equations.

[1]: Chapter 2 (Sections 2.6, and 2.7).

Weeks 14 and 15: Classification and reduction to canonical forms of second-order linear partial differential equations and their general solutions.

[1]: Chapter 4 (Sections 4.1 to 4.4).

Essential Readings

1. Myint-U, Tyn and Debnath, Lokenath (2007). Linear Partial Differential Equations for Scientist and Engineers (4th ed.). Birkhäuser. Indian Reprint.

2. Ross, Shepley L. (1984). Differential Equations (3rd ed.). John Wiley & Sons.