[3] S. Willard, *General Topology*, Addison Wesley, New York, 1968.

[4] J. Dugundji, *Topology*, Allyn and Bacon, Boston, 1966.

[5] J. L. Kelley, *General Topology*, Van Nostrand Reinhold Co., New York, 1955.

MTS 456	Ordinary Differential Equations	4 Credits (48 hours)

Course Objectives

1. **Study Linear Differential Equations:** Understand linear dependence, the Wronskian, and methods for solving linear differential equations, including variations of parameters and equations with constant coefficients.
2. **Explore Power Series Solutions:** Analyze second-order linear equations with ordinary and singular points, including Legendre and Bessel equations.
3. **Examine Systems of Linear Differential Equations:** Learn to solve systems of first-order equations, apply the fundamental matrix, and address non-homogeneous systems and systems with periodic coefficients.
4. **Understand Existence and Uniqueness:** Investigate the existence and uniqueness of solutions for differential equations, including methods of approximation and Picard's theorem.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Apply methods like the Wronskian, variation of parameters, and handle equations with constant coefficients.
2. Solve second-order linear equations using power series, and work with Legendre and Bessel equations.
3. Solve first-order linear systems, apply the fundamental matrix, and manage systems with periodic coefficients.
4. Use Picard's theorem and methods of successive approximation to analyze solutions and address non-uniqueness.
5. Apply techniques to determine the existence, uniqueness, and continuation of solutions to differential equations.

Contents

Unit I - Linear Differential Equations of Higher Order:

Linear dependence and the Wronskian, Basic theory for linear equations, Method of variation of parameters, Reduction of n^{th} order linear homogeneous equation, Homogeneous and non-homogeneous equations with constant coefficients.

(12 Hours)

Unit II - Solutions in Power Series:

Second order linear equations with ordinary points, Legendre equation and Legendre polynomials, Second order equations with regular singular points, Bessel equation. (18 Hours)

Unit III - Systems of Linear Differential Equations:

Systems of first order equations, Existence and uniqueness theorem. The fundamental matrix, Non-homogeneous linear systems, Linear systems with periodic coefficients. (12 Hours)

Unit IV - Existence and Uniqueness of solutions :

Equations of the form $x' = f(t, x)$, Method of successive approximation, Lipschitz condition, Picard's theorem, Non uniqueness of solutions, Continuation of solutions. (6 Hours)

References

[1] S. G. Deo and V. Raghavendra, *Ordinary Differential Equations and Stability Theory*, Tata McGraw Hill, 1980.

[2] A. Coddington, *An Introduction to Ordinary Differential Equations*, Prentice Hall of India, 2013.

[3] A. Coddington and N. Levinson, *Theory of Ordinary Differential Equations*, Krieger, 1984.

[4] M. W. Hirsh and S. Smale, *Differential Equations, Dynamical Systems and Linear Algebra*, Academic Press, New York, 1974. 5. V. I. Arnold, Ordinary Differential Equations, MIT Press, Cambridge, 1981.

[5] Shepley L. Ross, *Differential Equations*, Wiley, 2004.

MTS 459	Graph Theory	4 Credits (48 hours)

Course Objectives

1. **Understand Fundamental Graph Theory Concepts**: Gain a thorough understanding of the basic concepts in graph theory, including subgraphs, vertex degrees, paths, connectedness, and various operations and products on graphs.
2. **Explore Connectivity in Graphs**: Develop knowledge of connectivity in graphs, including vertex and edge cuts, blocks, and important theorems such as Menger's theorem.
3. **Analyze Trees and Special Graphs**: Study the properties and characterization of trees, understand the concepts of centers and centroids, and learn methods for counting spanning trees. Explore the properties of Eulerian and Hamiltonian graphs.
4. **Learn Graph Colorability**: Understand the principles of graph colorability, including the chromatic number, and theorems related to coloring such as the Five Color Theorem and the chromatic polynomial.

Course Outcomes

1. Ability to define and work with subgraphs, calculate degrees of vertices, identify paths and connected components, and apply various operations and products on graphs.
2. Proficiency in analyzing graph connectivity, including identifying and utilizing vertex and edge cuts, understanding the concept of blocks, and applying Menger's theorem to solve problems.
3. Understanding the definition and characterization of trees, determining centers and centroids, counting spanning trees, and analyzing the properties of Eulerian and Hamiltonian graphs.