

**Course Title:** Operations Research

**Course Code:** MATH-404

**Course Type:** Major Math

**Prerequisites:** Linear Algebra

**Credit Hours:** 3 (3 + 0)

**Course Objectives:** After the completion of the course, students will be able to:

1. Develop a comprehensive understanding of linear programming and its applications.
2. Develop skills to solve optimization problems using the simplex method and other advanced techniques.
3. Introduce transportation and assignment models and their real-world applications.
4. Develop problem-solving skills for network flow problems including the shortest-route and maximal-flow problems.

**Course Contents:**

**Linear Programming (LP):** Mathematical formulation of LP models, Graphical LP solution of maximization and minimization problems.

**Simplex method:** LP model in equation form, Transition from graphical to algebraic solution, Simplex method, Artificial starting solution, M-Technique and two-phase technique, Special cases in the simplex method (degeneracy, alternative optima, Unbounded solutions, Infeasible solutions).

**Sensitivity Analysis:** Graphical sensitivity analysis, Algebraic sensitivity analysis (changes in right-hand-side of constraints, Changes in objective coefficients).

**Transportation Models:** North-west corner method, Least-cost method, Vogel's approximations method, Method of multipliers, Assignment model, Transshipment model.

**Network Models:** Basic concepts and definitions, Applications of network models, Shortest-route algorithms for networks (Dijkstra's algorithm, Floyd's algorithm), Maximal-flow algorithm.

**Recommended Books:**

1. Fischetti, M., *Introduction to Mathematical Optimization*, Independently published, 2019.
2. Gillett, B. E., *Introduction to Operations Research*, McGraw-Hill Companies, 1976.
3. Hillier, F. S. and Lieberman, G. J., *Operations Research*, McGraw-Hill, 7th edition, 2002.
4. Taha, H. A., *Operations Research - An Introduction*, Pearson, 11th edition, 2022.
5. Winston, W. L. and Venkataramanan, M., *Introduction to Mathematical Programming. Operations Research*, Duxbury Press, 4th edition, 2002.

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