**Linear Programming**

**Programme(s) in which it is offered: B.Sc.B.Ed. Mathematics**

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| --- | --- |
| **Course Category**: Elective | **Schedule of Offering**: Odd |
| **Course Credit Structure:** 3 | **Course Code:** MTH2122 |
| **Total Number of Hours: 3** | **Contact Hours Per Week: 3** |
| **Lecture:2** | **Tutorial:** 1 |
| **Practical:** 0, 0 | **Medium of Instruction:** English |
| **Date of Revision:** | **Skill Focus:** Employability |
| **Short Name of the Course:** Linear Programming | **Course Stream:** |
| **Grading Method:** Regular | **Repeatable:** Credit |
| **Course Level:** Beginner |  |

**Course Description**

This course is an elective course for B.Sc. B.Ed. Mathematics students. This course focusses on the basic concepts and theories of linear programming and its applications in real life problems. Students will also gain exposure to certain optimization tools.

**Course Introduction**

This course aims at introducing students to linear programming theory and its applications. The field of linear programming provides the appropriate methods for an efficient computation of optimal solutions of a problem which is modelled by a linear objective function and a set of linear constraints. At the end of this course, the students will be ready to model a problem as a linear programming problem and apply the appropriate method in order to find an optimal solution.

**Course Objective**

The objectives of the course are:

1. To discuss formulation of a linear programming model from a problem description
2. To discuss the simplex algorithm and its applications in solving linear programming problems
3. To develop a fundamental understanding of duality theory
4. To familiarise the students with algorithms for solving transportation and assignment problems
5. To explore the concepts and methods of Game theory

**Course Outcome**

At the end of the course students will be able to

1. State the theories and concepts used in linear programming
2. Apply the simplex method in linear programming
3. Apply appropriate theories, principles and concepts relevant to linear programming
4. Plan and design applications using techniques and procedures appropriate to the simplex method
5. Solve linear programming models using ideas and techniques some of which are at the forefront of the discipline

**PO-CO Mapping**

<This should explain how the Course Outcomes (CO) are mapped with the Programme Outcomes (PO). All programmes to have two generic POs which can map to all minors/proficiency courses and foundation/self-immersion courses. Please tick the respective cells only; leave the other cells blank.>

**PO-CO Mapping Matrix**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CO/PO Mapping | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
| CO1 | ✓ |  |  |  |  |  |
| CO2 |  | ✓ |  |  |  |  |
| CO3 | ✓ |  |  |  |  |  |
| CO4 |  | ✓ |  |  |  |  |
| CO5 |  |  | ✓ |  |  |  |

**Prerequisites and other constraints**

This course is offered to all students of B.Sc.B.Ed. Mathematics. There is no prerequisite course.

**Pedagogy**

The teaching-learning of the course is organized through lectures, problem-solving sessions and student presentations.

**Suggested Reading:**

1. Swarup, Gupta and Mohan (2010). Operations Research. Sulthanchand.
2. Gupta and Hira (1976). Operations Research. S Chand and Co. Pvt. Ltd.
3. Hadley (2002). Linear Programming. Narosa Publishing House.
4. Naidu, Rajendra and Rao (2011). Operations Research. I K International Publishing House Pvt. Ltd.
5. Veerachamy and Kumar (2020). Operations Research. Dreamtech Press.
6. Bazaraa, Jarvis and Sherali (2004). Linear Programming and Network Flows. 2nd Ed. John Wiley and Sons. India.

**Evaluation Pattern**

**Evaluation Matrix**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Continuous Internal**  **Assessment (CIA) Components\*** | **Component Type** | **Weightage Percentage** | **Total**  **Marks** | **Tentative Dates** | **Course Outcome Mapping** |
| Mid-semester exam | 33% of CIA | 50 | Around 9th week | 1, 2, |
| Assignment | 67% of CIA | 30 | End of each module | 1, 2, 3, 4, 5 |
| Quizzes/ Problem Solving | 10 | Every two weeks | 1, 2, 3, 4 |
| Presentations | 10 | End of two modules | 1, 2, 3, 4, 5 |
| CIA Marks | 30% | 100 |  |  |
| **ESE** | | 70% | 100 | End of the semester | 1, 2, 3, 4, 5 |  |

**Module Sessions**

**Module 1: Introduction to Linear Programming (15 hours)**

Introduction to linear programming problems (LPP), Mathematical formulation of the LPP with illustrations, Graphical method, General Linear programming problems, Canonical & standard form of LPP. Theory of Simplex method, Optimality and unboundedness, the Simplex algorithm, Simplex method in table format, Introduction to artificial variables, Two-phase method, Big-M method and their comparisons.

**Reading:**

1. Swarup
2. Gupta
3. Hadley

**Activities:**

1. Quiz
2. Assignment

**Module 2: Duality (15 Hours)**

Duality in LPP: Introduction, General Primal-Dual pair, Formulation of the Dual problem, Primal-Dual relationships, Duality theorems, Complementary slackness theorem, Duality & Simplex method, Economic interpretation of the Duality.

**Reading:**

1. Gupta
2. Veerachamy

**Activities:**

1. Quiz
2. Assignment

**Module 3: Transportation Problem and More (15 Hours)**

Transportation Problem (TP): LP formulation of TP, Existence of solution and Duality in TP, Solution of Transportation problems, North-West corner method, Least-Cost method and Vogel approximation method for determination of starting basic solution, Algorithm for solving transportation problem, Assignment problem and its mathematical formulation, Solution methods of Assignment problem, Special cases in Assignment problems.

**Reading:**

1. Swarup
2. Gupta

**Activities:**

1. Quiz
2. Assignment
3. Presentation

**Module 4: Games and Strategies (15 Hours)**

Introduction, Formulation of two persons zero sum games, solving two persons zero sum games, Maximin - Minimax principles, Games without saddle points, Games with mixed strategies, Graphical solution procedure to (2 x n) and (m x 2) games.

**Reading:**

1. Swarup
2. Gupta
3. Naidu
4. Veerachamy

**Activities:**

1. Quiz
2. Assignment
3. Presentation