

# MA3515: INTRODUCTION TO OPTIMIZATION

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## Effective Term

Semester A 2025/26

## Part I Course Overview

### Course Title

Introduction to Optimization

### Subject Code

MA - Mathematics

### Course Number

3515

### Academic Unit

Mathematics (MA)

### College/School

College of Science (SI)

### Course Duration

One Semester

### Credit Units

3

### Level

B1, B2, B3, B4 - Bachelor's Degree

### Medium of Instruction

English

### Medium of Assessment

English

### Prerequisites

MA2503 Linear Algebra

### Precursors

Nil

### Equivalent Courses

Nil

### Exclusive Courses

Nil

## Part II Course Details

### Abstract

This course introduces basic concepts and methods of optimization. It emphasizes equally all three aspects of understanding, algorithms and applications. It also equips students with computing techniques and ability of applying taught methods to solve practical problems.

### Course Intended Learning Outcomes (CILOs)

| CILOs |                                                                                                                                | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|-------|--------------------------------------------------------------------------------------------------------------------------------|---------------------|--------|--------|--------|
| 1     | explain clearly basic concepts of linear and non-linear programming.                                                           | 10                  | x      |        |        |
| 2     | solve problems of linear programming, integer programming and non-linear programming with fundamental methods in optimization. | 20                  | x      | x      |        |
| 3     | apply linear programming tools to solve two-person zero-sum games.                                                             | 20                  | x      | x      |        |
| 4     | apply mathematical and computational methods of optimization in formulating and solving real-life problems.                    | 20                  |        | x      | x      |
| 5     | the combination of CILOs 1-4                                                                                                   | 30                  | x      | x      | x      |

#### A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

#### A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

#### A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

### Learning and Teaching Activities (LTAs)

| LTAs |                       | Brief Description                                                                                                                                                                                          | CILO No.      | Hours/week (if applicable) |
|------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|
| 1    | Lecture               | Learning through teaching is primarily based on lectures.                                                                                                                                                  | 1, 2, 3, 4, 5 | 39 hours in total          |
| 2    | Take-home assignments | Learning through take-home assignments helps students understand techniques of basic methods in linear, integer and non-linear programming as well as their applications in solving optimization problems. | 1, 2, 3, 4    | after-class                |

|   |                     |                                                                                                                                                                                                                                                                                                   |         |             |
|---|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------|
| 3 | Projects            | Learning through project(s) helps students apply mathematical and computational methods of optimization in formulating and solving more sophisticated real-life problems on linear/integer/non-linear programming. It also helps students to communicate and collaborate effectively in the team. | 3, 4    |             |
| 4 | Online applications | Learning through online examples for applications helps students create and formulate mathematical models and apply to a range of practical problems in economics/science.                                                                                                                        | 4       | after-class |
| 5 | Math Help Centre    | Learning activities in Math Help Centre provides students extra help.                                                                                                                                                                                                                             | 1, 2, 4 | after-class |

**Assessment Tasks / Activities (ATs)**

|   | ATs                  | CILO No.   | Weighting (%) | Remarks ("- for nil entry)                                                                                                                                                                                      | Allow Use of GenAI? |
|---|----------------------|------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| 1 | Quizzes/Test/Midterm | 1, 2, 4    | 20            | Questions are designed for the part of the course to see how well the students have learned basic concepts of methods in linear programming and recognized their applications in solving optimization problems. | No                  |
| 2 | Hand-in assignments  | 1, 2, 3, 4 | 10            | These are skills based assessment to enable students to demonstrate techniques of applying optimization methods in a diversity of problems.                                                                     | Yes                 |

|   |                                 |            |   |                                                                                                                                                                                                |     |
|---|---------------------------------|------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 3 | Project(s)                      | 3, 4       | 0 | Students are assessed on their ability in applying mathematical and computational methods to solve real-life optimization problems, as well as on the presentation of solutions with analysis. | Yes |
| 4 | Formative take-home assignments | 1, 2, 3, 4 | 0 | The assignments provide students chances to demonstrate their achievements on techniques of optimization learned in this course.                                                               | Yes |

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**

3

**Minimum Examination Passing Requirement (%)**

30

**Additional Information for ATs**

30% Coursework 70% Examination (Duration: 3 hours, at the end of the semester) For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

**Assessment Rubrics (AR)****Assessment Task**

1. Quizzes/Test/Midterm

**Criterion**

Ability to understand the basic concepts of methods in linear programming and recognize their applications in solving optimization problems

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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**Assessment Task**

2. Hand-in assignments

**Criterion**

Ability to apply the techniques of optimization methods in a diversity of problems

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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**Assessment Task**

3. Projects

**Criterion**

Ability to apply mathematical and computational methods to solve real-life optimization problems and present the solutions with analysis

**Excellent (A+, A, A-)**

High

**Good (B+, B, B-)**

Significant

**Fair (C+, C, C-)**

Moderate

**Marginal (D)**

Basic

**Failure (F)**

Not even reaching marginal levels

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### Assessment Task

#### 4. Formative take-home assignments

##### Criterion

Ability to demonstrate students' achievements on techniques of optimization learned in this course

##### Excellent (A+, A, A-)

High

##### Good (B+, B, B-)

Significant

##### Fair (C+, C, C-)

Moderate

##### Marginal (D)

Basic

##### Failure (F)

Not even reaching marginal levels

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### Assessment Task

#### 5. Examination

##### Criterion

Ability to solve linear and non-linear programming problems with fundamental methods in optimization.

##### Excellent (A+, A, A-)

High

##### Good (B+, B, B-)

Significant

##### Fair (C+, C, C-)

Moderate

##### Marginal (D)

Basic

##### Failure (F)

Not even reaching marginal levels

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## Part III Other Information

### Keyword Syllabus

Examples of Optimization Problems. Simplex Method for Linear Programming Problems. Duality Theory of Linear Optimization. Sensitivity Analysis for Linear Programming Problems, Cutting Plane Methods for Integer Programming Problems, Two-person Zero-sum Games, The Fundamental Theorem and Computational Techniques.

### Reading List

#### Compulsory Readings

| Title |                                                                                                           |
|-------|-----------------------------------------------------------------------------------------------------------|
| 1     | Text(s): Paul R. Thie, “An Introduction to Linear Programming and Game Theory” , John Wiley & Sons, 1988. |

**Additional Readings**

| Title |     |
|-------|-----|
| 1     | Nil |