# MA4527: COMPUTATIONAL GEOMETRY

**Effective Term**
Semester A 2022/23

## Part I Course Overview

**Course Title**
Computational Geometry

**Subject Code**
MA - Mathematics
**Course Number**
4527

**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**
MA2504 Discrete Mathematics, or
MA2509 Discrete Mathematics

**Precursors**
Nil

**Equivalent Courses**
Nil

**Exclusive Courses**
Nil

# Part II Course Details

**Abstract**

This course provides an account of fundamental concepts of quantitative geometry and graphical techniques of geometric construction with experiments using computers. It helps students design algorithms and analyze their efficiency in solving geometric problems.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | evaluate fractal dimension and apply the Iterative Function System in generating fractals which resemble real-world objects. | 15 | x | | |
| 2 | design and implement algorithms of triangulation and of two-dimensional convex hull generation in geometric problems. | 20 | | x | x |
| 3 | characterize invariance properties of Euclidean geometry by groups of transformations. | 10 | x | | |
| 4 | describe and construct basic geometric shapes and concepts by computational means. | 15 | | x | |
| 5 | explain fundamental properties of Delaunay triangulation and sketch Voronoi diagrams. | 20 | | x | x |
| 6 | the combination of CILOs 1-5 | 20 | 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.

**Teaching and Learning Activities (TLAs)**

| | TLAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|---|---|---|---|
| 1 | Lectures | Learning through teaching is primarily based on lectures. | 1, 2, 3, 4, 5, 6 | 39 hours in total |
| 2 | Take-home Assignments | Learning through take-home assignments helps students apply principles and techniques of computational geometry to problems on fractals, triangulation of polygons and convex hulls. | 1, 2, 3, 4, 5 | after-class |

| | | | | |
|---|---|---|---|---|
| 3 | Project | Learning through project helps students implement mathematical and computational ideas of geometry to construct models/create computer graphics. It also helps students to communicate and collaborate effectively in the team. | 6 | after-class |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Test | 1, 2 | 15 | Questions are designed for the first part of the course to see how well students have learned concepts of fractals as well as algorithms for triangulation of polygons and making of convex hulls. |
| 2 | Hand-in assignments | 1, 2, 3, 4, 5 | 5 | These are skills based assessment which enables students to design and implement methods of computational geometry in problems of fractals, triangulations, convex hulls and Voronoi diagrams. |
| 3 | Project | 6 | 10 | Students are assessed on their ability in applying concepts and techniques of computational geometry to model construction, as well as on its presentation with analysis. |
| 4 | Formative take-home assignments | 1, 2, 3, 4, 5 | 0 | The assignments provide students chances to demonstrate their achievements on computational geometry learned in this course. |

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**
3

**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. Test

**Criterion**
Ability in problem solving

**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**
Understanding of concepts and applications

**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. Project

**Criterion**
Creativity and Team work ability

**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**
Study attitude

**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**
Comprehensive ability in independent problem solving

**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**
Fractal geometry. Triangulation of Points and Polygons, Convex Hulls, Voronoi Diagrams and Delaunay Triangulations. Line Arrangements. Application to Computer Graphics.

**Reading List**

**Compulsory Readings**

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

**Additional Readings**

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