# MA4534: COMPUTER GRAPHICS AND GEOMETRY

**Effective Term**
Semester A 2022/23

## Part I Course Overview

**Course Title**
Computer Graphics and Geometry

**Subject Code**
MA - Mathematics
**Course Number**
4534

**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 / MA1503 Linear Algebra with Applications; and
MA2508 Multi-variable Calculus

**Precursors**
Nil

**Equivalent Courses**
Nil

**Exclusive Courses**
Nil

# Part II Course Details

**Abstract**

This course introduces the basics of curves and surfaces generations in computer aided geometric designs. It helps students understand how complex objects are modeled in the computer and how to generate computer images that resemble real-world objects.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | characterize invariance properties of Euclidean geometry by groups of transformations. | 15 | x | | |
| 2 | state and prove rigorously geometric properties of convex sets and polyhedral. | 15 | | x | |
| 3 | explain differential properties of curves/ surfaces by differential geometry and its application in computer-aided designs. | 20 | | x | x |
| 4 | describe basic properties of Bézier curves and generate such curves via computer graphics. | 15 | x | x | |
| 5 | evaluate fractal dimension and apply the Iterative Function System in generating fractals which resemble real-world objects. | 15 | 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 understand geometric properties of solids and differential properties of curves/ surfaces, as well as apply knowledge of which in computer-aided designs. | 1, 2, 3, 4, 5 | after-class |

| | | | | |
|---|---|---|---|---|
| 3 | Project(s) | Learning through project(s) helps students implement mathematical knowledge and computing techniques of geometry to construct models/generate computer graphics. It also helps students to communicate and collaborate effectively in the team. | 3, 4 | after-class |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Test | 1, 2, 3 | 15 | Questions are designed for the first part of the course to see how well students have learned basic properties of geometric shapes, differential properties of curves/surfaces and their applications in generating computer graphics. |
| 2 | Hand-in assignments | 1, 2, 3, 4, 5 | 5 | These are skills based assessment which enables students to apply knowledge of curves, surfaces and solids in geometric problems, as well as to understand non-classical geometry via fractals. |
| 3 | Project | 3, 4 | 10 | Students are assessed on their ability in applying techniques of computational geometry to model construction/ graphics generation, 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

**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**
Transformations, convex sets, polyhedral, platonic solids, curves in space, Bézier curves, B-spline, fractal dimension, iterated function systems.

**Reading List**

**Compulsory Readings**

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

**Additional Readings**

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