

# MA4545: APPLIED DIFFERENTIAL GEOMETRY

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## Effective Term

Semester A 2024/25

## Part I Course Overview

### Course Title

Applied Differential Geometry

### Subject Code

MA - Mathematics

### Course Number

4545

### 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

MA3511 Ordinary Differential Equations

### Precursors

Nil

### Equivalent Courses

Nil

### Exclusive Courses

Nil

## Part II Course Details

### Abstract

This course covers the basic theory of curves and surfaces in the 3-dimensional Euclidean space. It provides students with an introduction to the subject of differential geometry, and trains them to apply techniques in problems in shell theory and cartography.

### Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1 explain concepts of curves and surfaces at high level.	20	x		
2 understand the theory of curves, explain the definitions and properties of curvature and torsion.	20	x		
3 understand the theory of surfaces and apply properties of the first and second fundamental forms to shell theory.	20		x	
4 explain the definitions and properties of the Gaussian curvature and recognize the applications to cartography.	20		x	x
5 the combination of CILOs 1-4.	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.

### Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1 Lectures	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 basic concepts and theories of curves and surfaces.	1, 2, 3, 4	after-class
3 Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 2, 3, 4	after-class

### Assessment Tasks / Activities (ATs)

ATs		CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quizzes/Test/Midterm	1, 2	21	Questions are designed for the first part of the course to see how well students have learned the concepts and theories of curves.
2	Hand-in assignments	1, 2, 3, 4	9	These are skills based assessment to help students understand properties of curves and surfaces.
3	Formative take-home assignments	1, 2, 3, 4	0	The assignments provide students chances to demonstrate their achievements on differential geometry learned in this course.

**Continuous Assessment (%)**

30

**Examination (%)**

70

**Examination Duration (Hours)**

2

**Additional Information for ATs**

30% Coursework

70% Examination (Duration: 2 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 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. 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**

4. 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

## Part III Other Information

**Keyword Syllabus**

Regular curves, Frenet formula, local theory of curves, regular surfaces, first and second fundamental forms, Gaussian curvature and mean curvature, Gaussian map, Gauss Theorema Egregium, special surfaces such as ruled surfaces, surfaces of revolution, and minimal surfaces, Gauss-Bonnet theorem.

**Reading List****Compulsory Readings**

Title	
1	Schaum's Outline of Theory and Problems of Differential Geometry, by M. M. Lipschutz, McGraw-Hill, 1970
2	Differential Geometry of Curves and Surfaces, by M. do Carmo, Prentice-Hall, 1976

**Additional Readings**

Title	
1	Nil