

MA4545: APPLIED DIFFERENTIAL GEOMETRY

Effective Term

Semester A 2025/26

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 ("-" for nil entry) | Allow Use of GenAI? | |
|-----|---------------------------------|---------------|-----------------------------|--|-----|
| 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. | No |
| 2 | Hand-in assignments | 1, 2, 3, 4 | 9 | These are skills based assessment to help students understand properties of curves and surfaces. | Yes |
| 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. | Yes |

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

30

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

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

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

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 |