MA4552: INTRODUCTION TO DIFFERENTIAL MANIFOLDS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Introduction to Differential Manifolds

Subject Code
MA - Mathematics
Course Number
4552

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 aims at providing some basic theory on differential manifolds. It provides students with an introduction to topics in differential manifolds and prepares them for further study in advanced differential geometry.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain concepts of differential manifolds, tangent spaces, and submanifolds	25	x		
2	understand the theory of submersion, immersion, and embedding	20	x	x	
3	explain the concepts of Lie group, Lie algebra, and vector fields.	15	x		
4	understand the definitions and theory of vector bundles, fiber bundles, and cotangent bundles	25	x	x	
5	Explain the concepts of tensor, Riemannian metric, and Riemannian manifolds	15			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 assignment	Learning through take-home assignments helps students understand basic concepts and theories of curves and surfaces.	1, 2, 3, 4, 5	After-class
3	Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 2, 3, 4, 5	After class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Test	1, 2	20	Questions are designed for the first part of the course to see how well students have learned the concepts of differential manifolds	No
2	Hand-in assignments (3 or above)	1, 2, 3, 4	20	These are skills based assessment to help students understand concepts in differential manifolds.	Yes
3	Formative take-home assignments	1, 2, 3, 4	0	The assignmentsprovide studentschances to demonstratetheir achievements ondifferential manifoldslearned in this course.	Yes

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

40% Coursework 60% 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. 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

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
Differential manifolds, tangent spaces, submanifolds, Whitney’ s embedding theorem, vector fields and Lie algebra, vector bundles and cotangent bundles, tensors, Riemannian manifolds.

Reading List

Compulsory Readings

	Title
1	Introduction to Smooth Manifolds (2nd Edition), J. M. Lee, Springer
2	Fundamentals of Differential Geometry, S. Lang, Springer

Additional Readings

	Title
1	A Comprehensive Introduction to Differential Geometry (I~V), M. Spivak, Publish or Perish, Inc.