MA3514: NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Numerical Methods for Differential Equations

Subject Code
MA - Mathematics
Course Number
3514

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
MA3525 Elementary Numerical Methods

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to apply numerical methods and scientific computing techniques for ordinary and partial differential equations. It trains students to design computer programs and apply them to solve differential equations.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Students will understand mathematical ideas of numerical methods in solving ordinary and partial differential equations.		x	x	
2	Students will learn how to implement computing software packages (including MATLAB) as differential equation solvers.		x	x	
3	Students will learn how to evaluate solutions of differential equations with appropriate software package(s).		x	x	
4	Students will learn how to apply numerical and computational methods for solving initial and boundary value problems.		x	x	
5	the combination of CILOs 1-4		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	Lecture	Students will learn by lectures	1, 2, 3, 4, 5	39 hours in total
2	Take-home assignments	Students will learn through take-home assignments which will help students understand basic concepts and numerical techniques for solving initial value and boundary value problems, with implementation in analyzing concrete problems.	1, 2, 3, 4	after-class

3	Online applications	Students will learn through project(s) which will help students apply numerical and computational methods in solving more sophisticated ordinary/ partial differential equations and will help students to communicate and collaborate effectively in the team.	2, 3, 4	after-class
4	Math Help Centre	Students will get extra help from Math Help Centre.	1, 3, 4	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quizzes/Test/Midterm	1, 3, 4	24	Students will solve questions for the first part of the course to see how well they have learned mathematical concepts and techniques of solving initial value problems for ordinary differential equations numerically.
2	Hand-in assignments	1, 2, 3, 4	0	Students will demonstrate techniques of solving differential equations via numerical methods and analyzing solutions with the aid of computing software packages in these assessments.
3	Project(s)	2, 3, 4	0	Students are assessed on their ability in applying numerical and computational methods to solve more sophisticated differential equations, as well as on the presentation of numerical results with analysis.
4	Formative take-home assignments	1, 2, 3, 4	6	Students will have chances to demonstrate their achievements on solving and analyzing solutions of initial value and boundary value problems numerically.

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 to develop accurate and effective numerical methods and compute correctly

Excellent (A+, A, A-)

Demonstrates a thorough understanding of the concepts and techniques in numerical methods for differential equations and can always apply this understanding to solve a range of problems.

Good (B+, B, B-)

Demonstrates a substantial understanding of the concepts and techniques in numerical methods for differential equations and can usually apply this understanding to solve some problems.

Fair (C+, C, C-)

Demonstrates a general understanding of the concepts and techniques in numerical methods for differential equations and can sometimes apply this understanding to solve some problems.

Marginal (D)

Demonstrates a partial understanding of the concepts and techniques in numerical methods for differential equations and can rarely apply this understanding.

Failure (F)

Demonstrates a little or some misunderstanding of the concepts and techniques in numerical methods for differential equations and can rarely or almost never apply this understanding.

Assessment Task

2. Hand-in assignments

Criterion

Ability to develop accurate and effective numerical methods and compute correctly

Excellent (A+, A, A-)

Can always develop accurate and effective numerical methods and compute correctly.

Good (B+, B, B-)

Can usually develop accurate and effective numerical methods and compute correctly.

Fair (C+, C, C-)
Can sometimes develop accurate and effective numerical methods and compute correctly.

Marginal (D)
Can rarely develop accurate and effective numerical methods and compute correctly.

Failure (F)
Cannot develop accurate and effective numerical methods nor compute correctly.

Assessment Task
3. Projects

Criterion
Ability to implement numerical methods of differential equation in MATLAB

Excellent (A+, A, A-)
Can always implement numerical methods of differential equation in MATLAB.

Good (B+, B, B-)
Can usually implement numerical methods of differential equation in MATLAB.

Fair (C+, C, C-)
Can sometimes implement numerical methods of differential equation in MATLAB.

Marginal (D)
Can rarely implement numerical methods of differential equation in MATLAB.

Failure (F)
Cannot implement numerical methods of differential equation in MATLAB.

Assessment Task
4. Formative take-home assignments

Criterion
Ability to develop accurate and effective numerical methods and compute correctly

Excellent (A+, A, A-)
Can always develop accurate and effective numerical methods and compute correctly.

Good (B+, B, B-)
Can usually develop accurate and effective numerical methods and compute correctly.

Fair (C+, C, C-)
Can sometimes develop accurate and effective numerical methods and compute correctly.

Marginal (D)
Can rarely develop accurate and effective numerical methods and compute correctly.

Failure (F)
Cannot develop accurate and effective numerical methods nor compute correctly.

Assessment Task

5. Examination

Criterion

Ability to develop accurate and effective numerical methods and compute correctly

Excellent (A+, A, A-)

Can always develop accurate and effective numerical methods and compute correctly.

Good (B+, B, B-)

Can usually develop accurate and effective numerical methods and compute correctly.

Fair (C+, C, C-)

Can sometimes develop accurate and effective numerical methods and compute correctly.

Marginal (D)

Can rarely develop accurate and effective numerical methods and compute correctly.

Failure (F)

Cannot develop accurate and effective numerical methods nor compute correctly.

Part III Other Information

Keyword Syllabus

Numerical Methods for Initial Value Problems of ODE's. Finite Difference Methods for Two-Point Boundary Value Problems. Finite Difference Methods for Partial Differential Equations. Finite Element Methods for Two-Point Boundary Value Problems

Reading List

Compulsory Readings

	Title
1	Notes from the instructor
2	Numerical Methods for Ordinary Differential Equations: Initial Value Problems; D. Griffiths and D J Higham; Springer 2010
3	Introduction to Numerical Methods in Differential Equations, M Holmes, Springer, 2007

Additional Readings

	Title
1	Nil