MA3514: NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS

Effective Term
Semester A 2022/23

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	explain mathematical ideas of numerical methods in solving ordinary and partial differential equations.		x	x	
2	implement computing software packages (including MATLAB) as differential equation solvers.		x	x	
3	evaluate solutions of differential equations with appropriate software package(s).		x	x	
4	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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	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 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	Learning through project(s) helps students apply numerical and computational methods in solving more sophisticated ordinary/ partial differential equations. It also helps students to communicate and collaborate effectively in the team.	2, 3, 4	after-class
4	Math Help Centre	Learning activities in Math Help Centre provides students extra help.	1, 3, 4	after-class
5	Lecture	Learning through teaching is primarily based on lectures.	1, 2, 3, 4, 5	39 hours in total

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 3, 4	24	Questions are designed for the first part of the course to see how well the students 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	These are skills based assessment to enable students to demonstrate techniques of solving differential equations via numerical methods and analyzing solutions with the aid of computing software packages.
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	The assignments provide students 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-)

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

Ability to develop accurate and effective numerical methods and compute correctly

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. Projects

Criterion
Ability to implement numerical methods of differential equation in MATLAB

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
Ability to develop accurate and effective numerical methods and compute correctly

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
5. Formative take-home assignments

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

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
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