MA4538: NUMERICAL PARTIAL DIFFERENTIAL EQUATIONS

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Numerical Partial Differential Equations

Subject Code
MA - Mathematics
Course Number
4538

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
MA3525 Elementary Numerical Methods

Precursors
MA3511 Ordinary Differential Equations

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course gives students the opportunity for a further study in numerical methods for the solutions of partial differential equations. Students are also required to do mini-projects so that they will be able to apply what they have learned to problems in science and engineering.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain clearly concepts such as consistency, convergence and stability of numerical methods in solving partial differential equations.	15	x		
2	apply finite difference methods to various types of partial differential equations.	25		x	
3	create and formulate basic finite element approximations for boundary value problems in one or two variables.	25			x
4	apply sophisticated numerical methods to solve some complicated partial differential equations effectively on a computer.	15		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.

Teaching and Learning Activities (TLAs)

	TLAs	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 numerical techniques of partial differential equations and carry out stability and convergence analyzes for these methods.	1, 2, 3, 4	after-class

3	Project(s)	Learning through project(s) helps students apply mathematical knowledge and numerical methods to analyze/ solve boundary value problem(s) arising from practical applications. It also helps students to communicate and collaborate effectively in the team.	4	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 2, 3	15	Questions are designed for the first part of the course to see how well the students have learned basic numerical methods in solving partial differential equations, including finite difference and finite element methods.
2	Hand-in assignments	1, 2, 3, 4	5	These are skills based assessment to help students implement numerical techniques in solving various types of partial differential equations and analyzing their solutions.
3	Project	4	10	Students are assessed on their ability in applying numerical and computational methods to solve partial differential equations, as well as on the presentation of numerical results with analysis.
4	Formative take-home assignments	1, 2, 3, 4	0	The assignments provide students chances to demonstrate their achievements in solving and analyzing solutions of 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 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. Project

Criterion
Creativity and Team work ability

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. 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
5. 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
Description and numerical analysis of the main approximation methods for stationary and time-dependent boundary value problems: Finite differences, finite elements, spectral and collocation methods. Stability, consistency and convergence.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Nil