MA4531: PARTIAL DIFFERENTIAL EQUATIONS II

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Partial Differential Equations II

Subject Code
MA - Mathematics
Course Number
4531

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
MA3512 Partial Differential Equations

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to review the classical aspects of partial differential equations and to introduce some modern aspects of mathematical analysis of boundary value problems. In particular, basic topics such as the notion of weak solutions, the maximum principle, the distributions of eigenvalues, or the Euler-Lagrange equations, will be introduced and illustrated, often by considering the simpler case of one-dimensional spatial variable.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	explain clearly results from classical and modern formulation of boundary value problems in one space variable.	15	x		
2	describe structural/analytic properties of Sobolev spaces and their applications in analysis of boundary value problems.	20	x	x	x
3	apply eigenfunction expansion methods to solve non-homogeneous versions of diffusion and wave equations.	15		x	x
4	state and formulate the one-dimensional Euler-Lagrange equation.	15	x	x	
5	describe mathematically maximum principle of the Laplace operator and one-dimensional conservation laws.	15		x	
6	the combination of CILOs 1-5	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, 6	39 hours in total

2	Take-home assignments	Learning through take-home assignments helps students understand more advanced theory and functional analytic techniques of partial differential equations, with applications in mathematical physics.	1, 2, 3, 4, 5	after-class

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Test	1, 3	15	Questions are designed for the first part of the course to see how well the students have learned classical results in the theory of one-dimensional boundary value problems as well as properties of the heat and Laplace equations.
2	Hand-in assignments	1, 2, 3, 4, 5	15	These are skills based assessment to help students understand advanced theory and functional analytic techniques of partial differential equations, and their applications in mathematical physics.
3	Formative take-home assignments	1, 2, 3, 4, 5	0	The assignments provide students chances to demonstrate their achievements in more advanced techniques of partial differential equations learned from this course.

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. 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
Classical and variational formulations of stationary and time-dependent boundary value problems in one space variable. Sobolev Spaces in One Dimension. Lax-Milgram Lemma. Eigenvalues and Eigenfunctions. Euler-Lagrange Equation in One Variable. Maximum Principle for the Laplace Operator and the Heat Equation. Introduction to Conservation Laws in One Dimension.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Nil