City University of Hong Kong
Course Syllabus

offered by College/School/Department of Mathematics
with effect from Semester A 20 22 / 23

Part I Course Overview

Course Title:	**Numerical Partial Differential Equations**
Course Code:	**MA6612**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**P6**
Medium of Instruction:	**English**
Medium of Assessment:	**English**
Prerequisites: *(Course Code and Title)*	**Nil**
Precursors: *(Course Code and Title)*	**Nil**
Equivalent Courses: *(Course Code and Title)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

This course aims to

- introduce further numerical methods for the solutions of partial differential equations; and
- provide an overview of criteria for analyzing stability and accuracy properties of numerical solutions of boundary value problems.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	explain mathematical theory underlying basic numerical methods for the solutions of partial differential equations.	20%	✓		
2.	perform stability and convergence analysis to investigate applicability of numerical methods for solving partial differential equations.	20%	✓		
3.	carry out finite difference and finite element methods to approximate solutions of initial-boundary value problems.	20%	✓	✓	
4.	implement discretization methods, including spectral collocation and Galerkin approximation, to special types of partial differential equations.	20%	✓	✓	
5.	apply numerical and computational methods to obtain and analyze solutions of partial differential equations arising in physical science.	20%		✓	✓
		100%			

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 self-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.

3. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5	**6**	
Lectures	Learning through **teaching** is primarily based on lectures.	✓	✓	✓	✓	✓		39 hours in total
Take-home Assignments	Learning through **take-home assignments** helps students implement and analyze numerical methods for approximating solutions of partial differential equations.	✓	✓	✓	✓			after-class
Project(s)	Learning through **project(s)** helps students obtain approximate solutions of physically-arising initial/boundary value problems with mathematical justification by principles and numerical techniques introduced in this course.					✓		after-class

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

30% Coursework

70% Examination (Duration: 3 hours, at the end of the semester)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5	6		
Continuous Assessment: __30__%								
Test	✓	✓	✓				15--30%	Questions are designed for the first part of the course to see how well the students have learned mathematical criteria for analyzing numerical methods of solving partial differential equations, as well as the methods of finite difference and finite element.
Hand-in assignments	✓	✓	✓	✓	✓		0--15%	These are skills-based assessment which enables students to demonstrate techniques of approximating solutions of partial differential equations by numerical methods and analyzing accuracy of solutions with the aid of computing softwares.
Project(s)					✓		0--15%	Students are assessed on their ability in implementing numerical and computational techniques to formulate physical applications as initial/boundary value problems, as well as on the presentation of numerical results with analysis.
Examination: _70___% (duration: 3 hrs, if applicable)								Examination questions are designed to see how far students have achieved their intended learning outcomes. Questions will primarily be skills and understanding based to assess the student's versatility in numerical methods of solving partial differential equations.
							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Test	Independent problem solving skills on progressive learning based on lecture	High	Significant	Basic	Not even reaching marginal levels
2. Hand-in assignments	Understanding based on both lecture and outsource reference	High	Significant	Basic	Not even reaching marginal levels
3. Project(s)	Comprehensive understanding and creativity on combination of class learning and relative resources	High	Significant	Basic	Not even reaching marginal levels
4. Examination	Comprehensive problem solving skills on learning materials	High	Significant	Basic	Not even reaching marginal levels

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	Independent problem solving skills on progressive learning based on lecture	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in assignments	Understanding based on both lecture and outsource reference	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Project(s)	Comprehensive understanding and	High	Significant	Moderate	Basic	Not even reaching marginal levels

	creativity on combination of class learning and relative resources					
4. Examination	Comprehensive problem solving skills on learning materials	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

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.

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Lecture Note by Graeme Fairweather and Ian Gladwell; and Lecture Note by Weiwei Sun.
2.	
3.	
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2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

1.	
2.	
3.	
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