City University of Hong Kong
Course Syllabus

offered by Department of Mathematics
with effect from Semester A 2017/18

Part I Course Overview

Course Title:	Advanced Partial Differential Equations I
Course Code:	MA8005
Course Duration:	One Semester
Credit Units:	3
Level:	R8
Proposed Area: *(for GE courses only)*	☐ Arts and Humanities ☐ Study of Societies, Social and Business Organisations ☐ Science and Technology
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	MA8006 Functional Analysis and Applications
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 some advanced aspects of the modern theory of linear and nonlinear partial differential equations, such as the existence of a solution to boundary value problems via Lax-Milgram lemma, fixed point theorems or the minimization of functionals.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs[#]	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain clearly mathematical formulation of stationary and time-dependent boundary value problems arising in physical problems	10%	✓	✓	
2.	Describe analytic and structural properties of Green's functions	10%	✓	✓	
3.	Find Green's functions for boundary value problems by various methods	20%		✓	✓
4.	Describe analytic properties of Sobolev spaces and their applications in analysis of boundary value problems	10%	✓	✓	
5.	Apply Lax-Milgram lemma and Brouwer's fixed point theorem to demonstrate existence of solutions to boundary value problems	20%	✓	✓	✓
6.	Derive some classical differential equations by using principles of calculus of variations	10%		✓	✓
7.	Obtain minimizers of functional on analytic function spaces as solutions of classical partial differential equations	20%		✓	✓
** If weighting is assigned to CILOs, they should add up to 100%.*		100%			

[#] Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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)

TLA	Brief Description	CILO No.							Hours/week (if applicable)
		1	2	3	4	5	6	**7**	
Lectures	Learning through teaching is primarily based on lectures	✓	✓	✓	✓	✓	✓	✓	3 hours/week
Assignments	Learning through take-home assignments helps students implement more advanced theory and functional analytic techniques of partial differential equations, with applications in mathematical physics	✓	✓	✓	✓	✓	✓	✓	After-class

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.							Weighting*	Remarks
	1	2	3	4	5	6	7		
Continuous Assessment: 70%									
Test	✓	✓	✓	✓				0-35%	Questions are designed for the first part of the course to see how well students have learned classical results in the theory of stationary and time-dependent boundary value problems as well as applications of Green's functions and Sobolev spaces in analysing solutions of boundary value problems.
Hand-in assignments	✓	✓	✓	✓	✓	✓	✓	35-70%	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.
Examination: 30% (duration: 3 hours)	✓	✓	✓	✓	✓	✓	✓	30%	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 advanced theory and techniques underlying solutions of partial differential equations.
** The weightings should add up to 100%.*								100%	

5. Assessment Rubrics

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Test	DEMONSTATION of the understanding of the first part of the course	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Hand-in assignments	DEMONSTRATION of the understanding of the basic materials	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Examination	DEMONSTRATION of skills and versatility in advanced theory and partial differential equations	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

Some basic boundary value problems in solid mechanics, Green's functions, maximum principle, weak formulations, introduction to Sobolev spaces, Lax-Milgram lemma, equivalence with the minimization of a functional, the fundamental theorem of the calculus of variations, Brouwer's theorem and applications.

2. Reading List

2.1 Compulsory Readings

1.	
2.	
3.	
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2.2 Additional Readings

1.	
2.	
3.	
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