City University of Hong Kong

Information on a Course
offered by Department of Mathematics
with effect from Semester A in 2009 / 2010

Part I

Course Title: Advanced Partial Differential Equations I

Course Code: MA8005

Course Duration: One Semester

No. of Credit Units: 3

Level: R8

Medium of Instruction: 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

1. Course Aims:

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)

Upon successful completion of this course, students should be able to:

No.	CILOs	Weighting (if applicable)
1.	explain clearly mathematical formulation of stationary and time-dependent boundary value problems arising in physical problems.	1
2.	describe analytic and structural properties of Green's functions.	2
3.	find Green's functions for boundary value problems by various methods.	2
4.	describe analytic properties of Sobolev spaces and their applications in analysis of boundary value problems.	2
5.	apply Lax-Milgram lemma and Brouwer's fixed point theorem to demonstrate existence of solutions to boundary value problems.	2
6.	derive some classical differential equations by using principles of calculus of variations.	2
7.	obtain minimizers of functionals on analytic function spaces as solutions of classical partial differential equations.	2

3. Teaching and Learning Activities (TLAs)

Indicative of likely activities and tasks students will undertake to learn in this course. Final details will be provided to students in their first week of attendance in this course.

TLAs	CILO No.	Hours/week
Learning through teaching is primarily based on **lectures**.	1--7	39 hours in total
Learning through **take-home assignments** helps students implement more advanced theory and functional analytic techniques of partial differential equations, with applications in mathematical physics.	1--7	after-class

4. Assessment Tasks/Activities

70% Coursework
30% Examination (Duration: 3 hours, at the end of the semester)

Assessment Tasks/Activities	CILO No.	Weighting (if applicable)	Remarks
Test	1--4	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 analyzing solutions of boundary value problems.
Hand-in assignments	1--7	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	1--7	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.

5. Grading of Student Achievement:

A−, A, A+

To achieve a grade of ***A***, a student should

- have complete, or close to complete, mastery of mathematical concepts and techniques in this course,
- ***and*** have demonstrated very high levels of fluency in mathematical writing and synthesis of knowledge, as evidenced by the successful application of theory and methods of solving partial differential equations.

B−, B, B+

To achieve a grade of ***B***, a student should

- have good or very good mastery of mathematical concepts and techniques in this course,
- ***and*** have demonstrated good to very good levels of fluency in mathematical writing and synthesis of mathematical knowledge in advanced partial differential equations.

C−, C, C+

To achieve a grade of ***C***, a student should have good working knowledge

- of mathematical concepts and techniques in this course,
- ***or, alternatively***, of most of the concepts and techniques in this course, together with some demonstrated ability to synthesize them in physical problems.

D

To achieve a grade of ***D***, a student should have some working knowledge

- of mathematical concepts and techniques in this course,
- ***or, alternatively,*** of some of the concepts and techniques in this course, together with some demonstrated ability to synthesize them in at least one physical application.

Part III

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.

Recommended Reading:

Text(s):

Online Resources: