# City University of Hong Kong

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

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**Part I**

Course Title: Functional Analysis and Applications

Course Code: MA8006

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)* Nil

Equivalent Courses: *(Course Code and Title)* Nil

Exclusive Courses: *(Course Code and Title)* Nil

**Part II**

**1. Course Aims:**

This course aims to give research students a solid training in theory of classical and modern functional analysis. It also develops applications to the existence of solutions in boundary value and interpolation problems.

## 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 properties of Banach and Hilbert spaces as well as bounded linear operators on such spaces. | 5 |
| 2. | state and apply theorems of classical functional analysis, e.g. Hahn-Banach extension theorem, Baire category theorem, Banach closed graph theorem, etc. to mathematical problems. | 2 |
| 3. | be familiar with concepts arising from weak topology, including weak convergence and weakly lower-semicontinuous functionals. | 2 |
| 4. | describe properties of some function spaces and their applications in analysis of boundary value problems. | 2 |
| 5. | apply concepts and techniques to classical problems of analysis and to demonstrate existence theorems for fundamental equations of mathematical physics. | 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--5 | 39 hours in total |
| Learning through **take-home assignments** helps students implement more advanced theory and techniques of functional analysis, with applications in mathematical physics. | 1--5 | 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--2 | 0-35% | Questions are designed for the first part of the course to see how well students have learned basic notions of functional analysis, including Banach and Hilbert spaces, bounded linear operators and the underlying main theorems. |
| Hand-in assignments | 1--5 | 35--70% | These are skills based assessment to help students understand advanced theory and |

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|---|---|---|---|
| | | | techniques of functional analysis, and their applications in mathematical physics. |
| Examination | 1--5 | 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 of classical and modern functional analysis. |

## 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 functional analysis.

***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 functional analysis.

***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:

Banach spaces and Hilbert spaces. The "great theorems" : Hahn-Banach extension theorem, Baire theorem, Banach-Steinhaus theorem, Banach closed graph theorem, Banach closed range theorem.

Recommended Reading:

Text(s):

Online Resources: