UNSW SCIENCE
SCHOOL OF MATHEMATICS AND STATISTICS

MATH5605

FUNCTIONAL ANALYSIS

Term 1, 2019

MATH5605 – Course Outline

Information about the course

Course Authority: Dr. G. Levitina

Lecturer: Dr. G. Levitina RC-6104, email `g.levitina@unsw.edu.au`.

Consultation: Please use email to arrange an appointment.

Credit, Prerequisites, Exclusions:

This course counts for 6 Units of Credit (6UOC).

There are no formal prerequisites for this course, but you will need to have seen quite a bit of linear algebra, such as in MATH2601 and some analysis, such as in MATH3611, and to have achieved good marks in these courses. Postgraduate students who do not have a strong background in analysis should consider doing MATH5705 Analysis first (or at least concurrently).

This course is a compulsory component of Pure Mathematics Honours. The course is usually not available to students who have not yet started Honours. Any such enrolment would require the permission of the Director of Undergraduate Studies or the Head of Department.

Exclusions: none.

Classes: There will be 4 classes per week. Two of them will be lectures and two are tutorials. Here is the timetable:

Lectures:	Tue 18:00	RC-3085
	Thu 18:00	RC-3085
Tutorials:	Tue 19:00	RC-3085
	Thu 19:00	RC-3085

Course aims

This course can be thought of as a continuation of Higher Analysis MATH3611. Functional analysis a central pillar of modern analysis, and we will cover its foundations. The main emphasis will be on the study of the properties of bounded linear maps between topological linear spaces of various kinds. This provide the basic tools for the development of such areas as quantum mechanics, harmonic analysis, stochastic calculus etc. It also has a very close relation to measure and integration theory (MATH5825). If time allows, we may touch on various applications.

Detailed course schedule

It is intended that the following topics will be covered in the following order.

(1) Normed linear spaces, bounded operators, Banach spaces.

(2) Functionals and Hahn-Banach theorems.

(3) The Baire-category theorem, the principle of uniform boundedness, the Banach-Steinhaus theorem, the open mapping theorem and the closed graph theorem.

(4) Hilbert space theory; orthonormality, the Riesz representation theorem, projections, convexity.

(5) Operators on Hilbert spaces, normal and selfadjoint operators, spectrum and resolvent, Spectral mapping theorem.

(6) Compact operators, their spectral data, the spectral theorem.

(7) (If time permits) Ideals of compact operators and their applications.

Assessment

Assessment in this course will consist of 5 class tests (4% each), two assignments (15%+15%) and a final examination (50%).

Revision test

There will be a short revision test, which will be available on Moodle as a self-check of your knowledge of pre-requisite material.

Class test

Rationale: The class tests are 15 minutes tests to be held during tutorials. These tests are intended to provide feedback and designed to make sure that you have mastered the basic material of the course.

The tests will be held every even week on Thursday during the tutorial. The exact schedule for each of the tests will be announced during lectures and will be available on Moodle. Any major changes will be communicated through lectures and/or Moodle announcements.

Resit of class test: If you are absent from the test, you must provide a medical certificate.

If you miss a class test and have required medical documents you will be permitted to take a resit version of the test. This resit will be offered at a time outside the usual class times.

Assignments

Rationale: Assignments will give an opportunity for students to try their hand at more difficult problems requiring more than one line of argument and also introduce them to aspects of the subject which are not explicitly covered in lectures.

In the assignment you are **required** to present a complete typed solution in PDF format. Handwritten assignments will NOT be accepted.

Acknowledge any help that you receive, either from a book, another student, or an internet source. Discussion of the problems with other students is allowed, but you must write your solutions yourself.

Assignments must be YOUR OWN WORK, or severe penalties will be incurred. You should consult the University web page on plagiarism. Late assignments will not be accepted without prior approval of the lecturers.

Task	Date Avail.	Date Due	Form of Submission	Weighting
Ass 1	Week 1	Fri Week 5	Written	15%
Ass 2	Week 6	Fri Week 10	Written	15%

The above schedule should be considered as a guide only, as it will not be strictly adhered to. In the case of assessment dates, no changes will be made without consultation with the class nor without confirmation being posted as an announcement on Moodle.

Examination

Duration: Two hours. **Weighting:** 50% of your final mark.

Further details about the final examination will be available in class closer to the time.

Additional resources and support

Problem Sheets

A set of problem sheets will be given out. These problems are for you to do to enhance mastery of the course. Occasionally, if there is a demand and/or need for it we will have a problem class, doing some of the problems on the sheets.

Lecture notes

A set of skeleton lecture notes containing only definitions and theorems (no proofs) will be provided on the course website. The full lecture notes will be uploaded on Moodle after the lectures.

Textbooks

No one textbook will cover all the material in the course, but selected chapters from the following books will be useful.

- J.B. Conway: A Course in Functional Analysis.
- W. Rudin: Functional Analysis.
- M. Reed and B. Simon: Methods of Modern Mathematical Physics. Vol.1 Functional Analysis.
- K. Yosida: Functional Analysis.

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development. It is common practice to discuss informally with students how the course and their mastery of it are progressing.

Student Learning Outcomes

Students taking this course will develop an appreciation of the basic concepts of Functional Analysis, including the study of operator theory and the study of topological function spaces. These methods will be useful for further study in a range of other fields, e.g. Quantum Theory, Stochastic calculus and Harmonic analysis.

Relation to graduate attributes: The above outcomes are related to the development of the Science Faculty Graduate Attributes, in particular: 1.**Research, inquiry and analytical thinking abilities**, 4. **Communication**, 6. **Information literacy**

Teaching strategies underpinning the course

New ideas and skills are introduced and demonstrated in lectures and problem sessions, then students develop these skills by applying them to specific tasks in problem sheets and assessments.

Rationale for learning and teaching strategies

We believe that effective learning is best supported by a climate of inquiry, in which students are actively engaged in the learning process. Hence this course is structured with a strong emphasis on problem-solving tasks in assessment tasks, and students are expected to devote the majority of their class and study time to the solving of such tasks.

Rationale for Assignments: Assignments will give an opportunity for students to try their hand at more difficult problems requiring more than one line of argument and also introduce them to aspects of the subject which are not explicitly covered in lectures.

Rationale for Examinations: The final examination will assess student mastery of the material covered in the lectures.

Assessment criteria: The main criteria for marking all assessment tasks will be clear and logical presentation of correct solutions.

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above.

Administrative matters

Additional Assessment

This is at
`http://www.maths.unsw.edu.au/currentstudents/additional-assessment`

Any student who has a final mark in the range 40-49 will be allowed to complete as additional assessment task which may raise their mark to 50.

School Rules and Regulations

Fuller details of the general rules regarding attendence, release of marks, special consideration etc are available via the School of Mathematics and Statistics Web page at `http://www.maths.unsw.edu.au/students/current/policies/studentpolicy.html`.

Plagiarism and academic honesty

Assignments must be YOUR OWN WORK, or severe penalties will be incurred. You should consult the University web page on plagiarism. Plagiarism is the presentation of the thoughts or work of another as one's own. Issues you must be aware of regarding plagiarism and the university's policies on academic honesty and plagiarism can be found at `http://www.lc.unsw.edu.au/plagiarism` and `http://www.lc.unsw.edu.au/plagiarism/plagiarism_STUDENTBOOK.pdf`.