Subject Information Guide

Complex and Functional Analysis

Semester 1, 2016

Administration and contact details

Host Department	**School of Mathematics**
Host Institution	**University of Wollongong**
Name of lecturer	**Aidan Sims**
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Subject details

Handbook entry URL	Click here to enter text.
Subject homepage URL	Click here to enter text.
Honours student hand-out URL	Click here to enter text.
Start date:	**2 March 2016**
End date:	**1 June 2016**
Contact hours per week:	**2-3 (3 will be scheduled; we will use what we need)**
Lecture day and time:	**Wednesday 9:30-12:30 EST**
Description of electronic access arrangements for students (for example, WebCT)	**Resources will be made available from time to time on the lecturer's personal website.**

Subject content

1. **Subject content description**
   We will study the basics of the theory of complex analysis and the basics of the theory of functional analysis. In complex analysis, we will investigate analycity of holomorphic functions, prove Cauchy's integral formula, develop the winding number

and the Global Cauchy theorem, and conclude with the Inverse-Mapping theorem, the Open-Mapping theorem and the Maximum Modulus principle. In functional analysis, we will define Banach spaces, linear functionals, and dual spaces and the Baire Category, Hahn-Banach, Open Mapping and Closed Graph theorems. We will discuss the weak* topology, Alaoglu's theorem and the Krein-Milman theorem.

2. Week-by-week topic overview

Week 1: Cauchy's Theorem
Week 2: Cauchy's Theorem/Analytic vs Holomorphic
Week 3: Consequences of holomorphicity
Week 4: Winding numbers/Global Cauchy Formula
Week 5: Global Cauchy Formula ctd
Week 6: Invertability/Openness/ Maximum-Modulus Principle
Week 7: Mid-session exam
Week 8: Normed spaces and Banach spaces
Week 9: Baire category and consequences
Week 10: Linear functionals and dual spaces
Week 11: Weak topologies
Week 12: The weak*-topology and consequences
Week 13: Revision

3. Assumed prerequisite knowledge and capabilities

It is assumed that students already have a basic working knowledge of the fundamentals of real analysis (the content of a standard first analysis course) and of complex numbers and elementary calculus. Familiarity with point-set topology and with Hilbert space would both be advantageous, but are not necessary.

4. Learning outcomes and objectives

After successful completion of this subject, students will
(i) Understand key definitions and use them to construct rigorous proofs
(ii) Apply skills to unseen problems, draw valid conclusions with clear argument
(iii) Understand the fundamentals of complex analysis, analytic continuations and holomorphicity
(iv) Understand the fundamentals of functional analysis, and the weak and weak*-topologies

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	Associated AQF Learning Outcome Descriptors for this subject

Demonstrate well-developed cognitive and technical skills in mathematics or statistics to select and apply mathematical or statistical methods to analyse and generate solutions to complex problems.	K1; S2; S3; A2
Demonstrate advanced theoretical and technical knowledge in mathematics or statistics.	K1; S1; S2; S3; A2
Transmit mathematical or statistical knowledge, skills and ideas to others.	K1; K2; S5

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Lecture notes will be provided as the course progresses. There are no specified texts, but the lecture notes have been prepared with reference to the following texts:

- Serge Lang, Complex Analysis
- Gert Pedersen, Analysis Now

6. Assessment

Exam/assignment/classwork breakdown					
Exam	50%	**Assignment**	30%	**Class work**	20%
Assignment due dates		Week 4	Week 8	Week 11	

Approximate exam date	15 June 2016

Institution Honours program details

Weight of subject in total honours assessment at host department	1/8
Thesis/subject split at host department	BMath (Hons): Thesis worth 25% BMathAdv (Hons): Thesis worth 37.5%
Honours grade ranges at host department:	
H1	85-100%
H2a	75-84%
H2b	65-74%
H3	50-64%