THE UNIVERSITY OF NEW SOUTH WALES

FACULTY OF SCIENCE

SCHOOL OF MATHEMATICS & STATISTICS

MATH5685
COMPLEX ANALYSIS

Semester 2 2012

MATH5685 – Course Outline

Information about the course

Course Authority: Associate Professor Ian Doust

Lecturer: Ian Doust **Room:** RC-6113, **Email:** `i.doust@unsw.edu.au`.

Consultation: Please use email to arrange an appointment.

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

Prerequisites: MATH2620 (or a very strong result in MATH2520) is assumed knowledge for this course. MATH3611 is recommended. Students who have not done their undergraduate study at UNSW should consult the lecturer for advice.

Lectures: There will be 36 lectures in total. The times will be decided at the timetabling meeting Thursday 12 July at 9:30am in RC-4082.

Blackboard: I don't plan to use Blackboard for this course. I'll let you know if I decide to put something up there!

Course aims

This course can be thought of as a continuation of Higher Complex Analysis MATH2620, and consists of a selection of more advanced topics in classical complex analysis. It is hoped that students find these topics interesting and intellectually satisfying. The course should provide a good foundation for further study in analysis.

Syllabus

It is intended that the following topics will be covered.

(1) Revision: Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Taylor series, Laurent's theorem, residues, the residue theorem, winding number, the argument principle, Rouche's theorem, the maximum modulus theorem

(2) A non-trivial example: the decomposition of $\pi\cot(\pi z)$ into partial fractions

(3) Analytic continuation and Riemann surfaces

(4) Uniform convergence.

(5) Infinite products, the Weierstrass Factorization Theorem.

(6) The Gamma function and the Riemann ζ-function.

(7) Conformal transformations: The Open Mapping Principle.

(8) Fractional linear transformations.

(9) The Riemann Mapping theorem, Schwarz's lemma

(10) A brief history of elliptic functions.

(11) Meromorphic periodic functions.

(12) Construction of elliptic functions, the Weierstrass $\mathcal{P}$ functions, the Weierstrass zeta and sigma functions.

Assessment

Overview:

Task	Due Date	Weighting
Assignment 1	week 3	10%
Assignment 2	week 6	20%
Assignment 3	week 10	20%
Exam		50%
Total		100%

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. We shall have one short assignment due early in the course to get you started and then two more substantial assignments due in weeks 6 and 10. (Assignments will be due at the start of the last lecture for that week.) Draconian late penalties will apply at the whim of the lecturer.

Exam: The final three hour examination will assess student mastery of the material covered in the lectures. The exam will be worth 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 for it we will have a problem class, doing some of the problems on the sheets.

Reference books

There are many, many books on complex analysis. Almost all cover the same beginning material that you will have studied in your first complex analysis course, but they will do this at different levels of rigour. There is much more choice in what one might cover in a second course, and this is reflected in the contents pages of these books.

I have listed here a couple of the books I am likely to consult while teaching the course, but you are encouraged to have a hunt through the appropriate section of the library to see if you can find a book that you find useful. Some book will make greater use of, and applications to, topology, geometry, or functional analysis, so which books you like will depend the author's style and on the mathematical background you bring to the course.

J.W. Brown & R.V. Churchill, Complex variables and applications. This is a good first book in complex analysis. It covers the assumed material well, and some, but not all, of the more advanced material that we'll cover in this course.

L.V. Ahlfors, Complex analysis. This is a classic complex analysis text, written at a slightly higher level than Brown & Churchill. It will cover almost all the course. BUT. . . it is a bit old-fashioned, and may be harder to read than some of the more modern treatments.

S. Lang, Complex analysis. Another very standard text, and one which covers the majority of what we will be doing. Lang can be an idiosyncratic author, but this books seems less quirky than some.

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 some of the more advanced concepts of Complex Analysis, and will develop their ability to work analytically.

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, 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.

School Rules and Regulations

Fuller details of the general rules regarding attendence, release of marks, special consideration, additional assessment etc are available via the School of Mathematics and Statistics Web page at

`http://www.maths.unsw.edu.au/currentstudents/student-services`

Note that their is no automatic additional assessment for students in the range 40–49 for MATH5xxx courses.

Plagiarism and academic honesty

Assignments must be YOUR OWN WORK. 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`.

This does not preclude you from consulting references and discussing questions with other people. It just means that you need to be clear and honest about where the ideas came from. This can usually be covered by a sentence such as 'This proof is based on the proof of Theorem 3.2.1 in ... ' or 'The clever idea to consider random subsets of Γ was provided by Fred'.

You don't need to reference definitions, theorems etc that you would expect everyone in the course to know (eg the Cauchy Integral formula, or the definition of an analytic function, or something from the lectures). On the other hand, if your proof depends on a slightly more unusual theorem (eg Jensen's formula), then you should (a) check that that theorem doesn't depend on the thing that you have been asked to prove, and (b) give a reference to where you found the result. Your solutions should be written so that a fellow student could read and follow what you have done — keep this in mind as you are writing up your work.

Obviously straight copying of someone else's assignment is both unethical and easily detected. You should never provide your written solutions to another student; inevitably their work will look just like yours and you'll both be penalized. If you work on a problem with a friend, make sure that you each write it up quite separately (and mention that you discussed the problem with your classmate). It is very easy to tell when someone has copied something and not understood it.

Serious cases of plagiarism will attract severe penalties.