FACULTY OF SCIENCE

SCHOOL OF MATHEMATICS & STATISTICS

MATH2520

COMPLEX ANALYSIS

Semester 2 2011
MATH2520 – Course Outline

Information about the course

Course Authority: David Crocker

Lecturer: David Crocker RC-3094, email d.crocker@unsw.edu.au.

Consultation: The lecturer’s consultation hours will be announced at lectures and on the MATH2520 Blackboard web page in week 2. To arrange an appointment outside the ”Definite” consultation hours, contact the lecturer by e-mail.

Credit, Prerequisites, Exclusions:
This course counts for 3 Units of Credit (3UOC).
MATH1131/MATH1231 is assumed knowledge for this course.
Exclusions: MATH2620.
There is a higher version of this subject, MATH2620 Higher Complex Analysis.

Lectures: There will be two lectures per week running in Weeks 1 to 12.
Lecture times and locations are:

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday 1 – 2 p.m.</td>
<td>Central Lecture Block 6</td>
</tr>
<tr>
<td>Wednesday 1 – 2 p.m.</td>
<td>Webster – A</td>
</tr>
</tbody>
</table>

Syllabus and Course Schedule
A Syllabus and Course schedule is located at the end of this handout.

Tutorials: There will be one tutorial per week running in Weeks 2 to 13 (12 tutorials). Hence tutorials start in Week 2.

Blackboard web page Further information, skeleton lecture notes, and other material will be provided via the Blackboard web pages for MATH2520 via UNSW Blackboard which can be accessed on the web at the address

http://Ims-blackboard.telt.unsw.edu.au

or by following the “UNSW Blackboard” links on the School of Mathematics and Statistics web pages at

http://www.maths.unsw.edu.au
Course aims

This course aims to extend our understanding of differential and integral calculus from functions of a single real variable to functions of a complex variable. The differences between the two are often unexpected and very surprising. The theory of complex valued functions will give us many new insights into the real variable theory.

Relation to other mathematics courses

Mathematics may be divided into the broad categories of analysis (calculus), algebra, geometry and logic.

This subject fits into the analysis category and follows on from material you will have learned in first year algebra and calculus.

This course is part of the compulsory core aimed at those majoring in Mathematics.

Student Learning Outcomes

Students taking this course will gain an understanding of the basic theory of functions of a complex variable. They will:

- understand the main properties and examples of analytic functions;
- be able to compute and manipulate series expansions for analytic functions;
- know and be able to use the major integral theorems;
- be able to identify and classify zeroes and poles of functions and find their residues;
- understand the relationship between complex function theory and the theory of functions of a real variable.
- be able to calculate certain real improper and trigonometric integrals using complex analytic methods.

New ideas and concepts will be introduced in lectures and then applied to specific tasks in tutorials.

Through regularly attending lectures and applying themselves in tutorial exercises, students will reach the above outcomes.
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 tutorials and assessments.

Rationale for learning and teaching strategies

We believe that effective learning is best supported by a climate of enquiry, in which students are actively engaged in the learning process. To ensure effective learning, students should participate in class as outlined below.

We believe that effective learning is achieved when students attend all classes, have prepared effectively for classes by reading through previous lecture notes, in the case of lectures, and, in the case of tutorials, by having made a serious attempt at doing for themselves the tutorial problems prior to the tutorials.

Furthermore, lectures should be viewed by the student as an opportunity to learn, rather than just copy down lecture notes.

Effective learning is achieved when students have a genuine interest in the subject and make a serious effort to master the basic material.

The art of logically setting out mathematics is best learned by watching an expert and paying particular attention to detail. This skill is best learned by regularly attending classes.
Assessment

Assessment in this course rewards students for working consistently at the tutorial problems throughout the session. It encourages the development of analytical thinking and the ability to understand and solve problems, and to express mathematics clearly in written form.

The **final mark** in MATH2520 will be a scaled aggregate mark based on

- two 30 minute class tests (in tutorials in Weeks 6 and 11) (10% each);
- a Class mark worth 5 % based on tutorial work and tutorial attendance;
- the **final two hour examination** (75%) covering all of the course.

The Class tests will be in tutorials.

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

Scaling of grades in MATH2520 will be performed in conjunction with the higher version of this course, MATH2620 Higher Complex Analysis, reflecting the greater difficulty of the higher course. Few, if any, High Distinctions and Distinctions will be given in MATH2520. Those seeking such grades should consider enrolling in the higher course. To enrol in the higher course, you need to have very good results from first year Mathematics or in other second year subjects.

**Class Mark Component**

The Class mark component of the assessment worth 5% will comprise 1% for attendance at tutorials, and 4% (in 2 lots of 2%) for the quality and consistency of written solutions to the tutorial problems. These solutions must be your own work and present in a **fixed page lined workbook** (such as an exercise book or bound lecture notes book) with your name and student number on the front. No loose sheets or stapled loose sheets of paper will be allowed.

You should bring these workbooks to tutorials and any solutions copied from the board should be clearly indicated under a heading such as “Tutorial – Week 3”. The rest (the majority!) should be your solutions to problems you have done outside of tutorials.

The **workbooks will be checked at the class tests times (Weeks 6 & 11)** by your tutor and a mark out of 2 will be recorded on each occasion.

The 1% attendance mark will be awarded only if you attend at least 75% of all tutorials other than those for which you have a medical certificate or similar documentation. Copies of such documents should be given to your tutor.
Test

Rationale: The Tests will give students feedback on their progress and mastery of the material. Sample Tests will appear on the UNSW Blackboard web pages for MATH2520.

You must do the test in your OWN tutorial in which you are enrolled.

You may bring your own non-programmable hand-held Scientific Calculator to the test. Calculators will not be provided for you.

<table>
<thead>
<tr>
<th>Task</th>
<th>Date</th>
<th>Weighting</th>
<th>Duration</th>
<th>Material tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test 1</td>
<td>Week 6</td>
<td>10%</td>
<td>30 mins</td>
<td>Lectures in Weeks 1-4 covered in tutorials Weeks 2-5</td>
</tr>
<tr>
<td>Test 2</td>
<td>Week 11</td>
<td>10%</td>
<td>30 mins</td>
<td>Lectures in Weeks 5-9 covered in tutorials Weeks 6-10</td>
</tr>
</tbody>
</table>

Absences at Class Tests

There are no “make-up” class tests, so if you miss a class test and and you fail to provide documentation for a satisfactory reason why you missed the test, then you will receive an A for absent which gives a mark of zero for the test.

If you are absent from the test, then to avoid an A mark, you must provide a medical certificate for an illness or similar documentation, for example for a sudden bereavement. In that case an M will be recorded and your final mark will be calculated from the other assessment tasks as follows:

- With one M for a class test, your non-class mark components (total 95% of final mark) will be re-weighted as:

  \[
  \text{other class test} = \frac{95}{85} \times 10 \approx 11.18\%, \quad \text{exam} = \frac{95}{85} \times 75 \approx 83.82\%;
  \]

- With two M marks for the class tests, your non-class mark component will be your exam mark re-weighted to 95%.

The class mark component will remain a fixed 5% of the final mark.

Past Class Tests

About 2 weeks prior to each test, a PDF of sample Past Class Tests for that test for the last 4 years or so will go up in the Course materials folder on Blackboard. Also solutions to the sample Class Tests for 2010 will be placed there as a PDF. No other solutions to Past Class Tests will be provided.
Examination

Duration: Two hours.

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

Weighting: The final examination will count for 75% of your final mark.

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

Past Exams and solutions

Near the end of session, a PDF of Past Exams and Solutions will be made available in the Course materials folder on Blackboard.

Additional resources and support

Tutorial Problems

A set of tutorial problems will be available as a PDF through the UNSW Blackboard web pages for MATH2520 in the folder “Tutorial Problems” in the “Course Materials” folder.

These problems are for YOU to do to enhance mastery of the course.

SOME of the problems may be done in tutorials, but you will learn a lot more if you try to do them before the tutorial.

No solutions to the tutorial problems will be published. If you wish to see a solution to a tutorial problem you are having trouble with, raise that problem in your tutorial with your tutor.

The tutorial problem set do have short answers but not solutions.

Lecture notes

A set of skeleton lecture notes for the course will appear on the UNSW Blackboard web pages for MATH2520 in the folder “Lecture Notes” in the “Course Materials” folder.

There will generally be one PDF per topic (12 topics in all) and you will be notified when the PDF for any topic is available for download.

These notes are not complete - in particular most examples listed in the notes are not solved in the notes - but will instead be done “live” at the lectures.

The notes therefore are NOT a substitute for attending lectures!
Textbooks

The text book for this course is:


You can use other editions.

While it is not mandatory that students buy this book for this course, it is an excellent supplementary reference book for the course providing further explanations of the theory, worked examples and extra problems.

There are a few copies (mainly older editions in the library) and there may be a few on sale at the 2nd hand bookshop.

A brand new copy of the 8th edition from the UNSW bookshop costs $159.95 (!!)

Another useful extra reference, particularly for worked solutions to problems is:


The content of the course will be defined by the lectures.

Blackboard web page

All course materials will be available on the UNSW Blackboard web pages for MATH2520 in the “Course Materials” folder. You should check regularly for new materials.

Maple

While there is no Maple component to be assessed in this course, every student in a mathematics course is given an account on the School of Mathematics and Statistics computer Sigma and hence has access to a recent version of Maple. They can access this account through the School’s computer labs in M020 and G012 in the School, Red Centre, Centre wing or remotely from another computer using NX Client for Windows, Linux or Mac. Instructions on remote access will be placed in the Computing folder in the Course materials folder on Blackboard.

Maple is ideally suited to computations with complex numbers and complex calculus. Many of Maple’s in-built functions are defined for a complex variable. Integration can be adapted to contour integration. The series command can compute Taylor and Laurent series, the residue command can compute residues at singularities. You may wish to check some of your work using Maple.
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.

Administrative matters

Additional Assessment

See the handout entitled Important Information for Undergraduate students which is attached to the version of the Course outline handout distributed at the first lecture.

For the on-line version of this Course outline, the information on Additional Assessment may be found on the School of Mathematics and Statistics Web page at Current Students > School Assessment Policies: Handout for Undergraduate students OR

Please read this document carefully!

In particular note the last section on Concessional Additional Assessment. Any student in second or later year mathematics courses who receives a preliminary final mark of 40 – 49 is automatically entitled to take the Additional Assessment exam and have a second chance at passing the course. The maximum final mark after Concessional Additional Assessment is 50.

It is up to each student to find out where and when the Additional exams are held. See section 7. of the document.

School Rules and Regulations

Fuller details of the general rules regarding attendance, 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

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
Syllabus and Course Schedule:

Here is a rough guide as to the schedule of material taught.

References are given to the “Text”:


<table>
<thead>
<tr>
<th>Theme</th>
<th>No. of Lects.</th>
<th>Weeks</th>
<th>Text</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction: Revision, basic topology functions and mappings</td>
<td>4</td>
<td>1,2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2. Limits, continuity, differentiability</td>
<td>2</td>
<td>3</td>
<td>2.15-2.22</td>
<td></td>
</tr>
<tr>
<td>3. Analytic and harmonic functions</td>
<td>2</td>
<td>4</td>
<td>2.24-2.26</td>
<td></td>
</tr>
<tr>
<td>4. Exponential, trigonometric and hyperbolic functions</td>
<td>1</td>
<td>5</td>
<td>3.29, 3.34-3.36</td>
<td></td>
</tr>
<tr>
<td>5. Principal logarithms, and and complex exponents</td>
<td>2</td>
<td>5,6</td>
<td>3.30-3.33</td>
<td>Test 1, Week 6 Themes 1-3</td>
</tr>
<tr>
<td>6. Arcs, contour integrals and antiderivatives</td>
<td>3</td>
<td>6,7</td>
<td>4.38-4.44</td>
<td></td>
</tr>
<tr>
<td>7. Cauchy-Goursat theorem and the Cauchy integral formula</td>
<td>1.5</td>
<td>8</td>
<td>4.46-4.51, 4.53</td>
<td></td>
</tr>
<tr>
<td>8. Taylor and Laurent Series</td>
<td>2</td>
<td>8, 9</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>9. Evaluating integrals</td>
<td>1.5</td>
<td>9,10</td>
<td>5</td>
<td>Test 2, Week 11 Themes 4-8</td>
</tr>
<tr>
<td>10. Singularities and residues</td>
<td>3</td>
<td>10,11</td>
<td>6 (except 6.71, 6.77)</td>
<td></td>
</tr>
<tr>
<td>11. Real Improper integrals</td>
<td>1</td>
<td>11</td>
<td>7.78-7.81</td>
<td></td>
</tr>
<tr>
<td>12. Trigonometric integrals</td>
<td>1</td>
<td>12</td>
<td>7.85</td>
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</table>