

University of New England

Faculty of Arts and Sciences

School of Science and Technology

PMTH333

Complex Analysis

Unit Information

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Semester 1, 2011

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Unit Information

Welcome

Welcome to PMTH333: Complex Analysis.

This unit is designed for students of the Bachelors degrees in Sciences or Arts, with a major or minor focus on mathematics and/or statistics, and for students of the combined Bachelors degree in Mathematics and Secondary Teaching. It provides a standard introduction to the theory of functions of a complex variable. An outline of topics of study for this unit is given in the introduction below.

Unit coordinator

Dr. Gerd Schmalz

Contact details

Please contact the unit coordinator for any matter relating to the academic content of this unit:

Email: gerd@turing.une.edu.au

Administrative contact

Student Centre

The Student Centre provides you with a focal point of contact for all your administrative enquiries during your study at UNE, including selecting units and managing your enrolment. If you have administrative enquiries relating to your study at UNE, go to the Student Centre page at <http://www.une.edu.au/studentcentre>.

Alternatively, you can go to [AskUNE](#) and submit a question by clicking on the 'Contact Us' tab.

You can also find information on all aspects of studying at UNE on the Current Students page at <http://www.une.edu.au/for/current-students/>.

School of Science and Technology

Email: hos-st@une.edu.au

Introduction

I. Complex Numbers (weeks 1-2):

1. Basic properties
2. The Argand Plane
3. Powers of z
4. Loci and Regions in the Complex Plane

II. Complex Functions (weeks 3-4):

1. Continuity of complex functions
2. The Complex Derivative
3. Harmonic Functions

III. Transcendental Functions (weeks 5-6):

1. The Exponential Function
2. Trigonometric and Hyperbolic Functions
3. The Complex Logarithm
4. Complex Exponents

IV. The Complex Integral (weeks 7-9):

1. Complex Path Integration
2. Cauchy's Theorem
3. The Fundamental Theorem of Calculus
4. The Cauchy Integral Formula
5. Applications of the Cauchy Formula

V. Complex Power Series (weeks 10-11):

1. Convergence of Complex Series
2. Uniform Convergence
3. Taylor Series
4. Laurent Series

VI. Residue Theory and Applications (weeks 12-13):

1. Complex Residues

2. Isolated Singularities

3. Applying Residues to Real Integration

Learning outcomes

On completion of this unit, you should be able to:

- Perform the basic arithmetic operations of complex numbers, including powers and extraction of multiple roots, using both the Cartesian and polar forms.
- Relate concepts of continuity and differentiability of real functions of two variables to the properties of harmonic and analytic functions of one complex variable.
- Locate singularities of a complex function and apply the formula of Cauchy (where needed) to evaluate path and contour integrals.
- Compute complex power series as a tool for classification of isolated singularities of complex functions.
- Combine all of the above in the analysis and application of residues.

Prescribed text

A set of printed lecture notes, covering the topics outlined

above, will be provided to all distance-education students in both streams separately with this information. An electronic version will also be provided on line for all students. The information contained in these notes is core material for completion of all assessment tasks and the exam in PMTH333, and should be used as a supplement to the following

Reference Book:

“Complex Variables and Applications” (Eighth edition) by J. Brown and R. Churchill

This book is prescribed for students taking PMTH333, and will be the source of assignment questions throughout the semester. The 8th edition is the current one. Prior editions have the disadvantage that page references made to the text from this study guide will not apply consistently, and so students may find it difficult to locate equivalent information in the 6th or earlier editions.

Textbook information, including options for purchasing the text, is available at <http://www.une.edu.au/studentcentre/textbook-info.php>.

UNE graduate attributes

UNE has a policy that identifies the special attributes of a UNE graduate. The policy can be found at <http://www.une.edu.au/gamanual/>. It is expected that, during the course of your undergraduate degree, you will develop these attributes in conjunction with your discipline knowledge. Those addressed by this unit are reflected in the unit learning outcomes and assessment tasks. You can assess your developing skill level after each unit by using the self-reflection guide and resources located at <http://www.une.edu.au/gamanual/students>.

Intensive school

There is no Intensive School for PMTH333.

Assessment

There will be 6 problem-based assignments, which will contribute 30% to the overall assessment for PMTH333. Detailed worked solutions to all assignment problems will be provided on return of the marked assignment scripts to off-campus students. The due dates for assignments listed in the study timetable below are subject to school policy. The standard way of assignment submission for external students is e-submission. To do so scan your (handwritten) assignments into a pdf file or use pdflatex to produce the pdf file. Upload it through the e-submission website <http://www.une.edu.au/tlc/learningresources/e-submission.php>.

Alternatively, you may send your assignments by post. In this case you need to attach a cover sheet. Cover-sheets will need to be downloaded from the e-submission website. This is only possible before the due date.

Extensions beyond the due date for a given assignment may be granted if a request for extra time has been made to the coordinator by email in advance. The assignment questions and page references in the study timetable below are taken from Brown and Churchill (8th edition).

Final Exam:

There will be one 2-hour exam paper, which will contribute 70% to the final assessment for both streams. All students must achieve a mark of at least 40% on the final exam (i.e., equivalent to 28/70) in order to pass the unit. Note this is a necessary, but not sufficient condition for passing. You may take 5 A4 sheets (10 pages) of handwritten notes into the exam. No photocopies or printed material is allowed.

Study timetable

Week	Topics/events (see introduction and assessment)	Assessment due
Week 1	Lecture notes, sections 1.1,1.2	
Week 2	Lecture notes, sections 1.3,1.4	
Week 3	Lecture notes, sections 2.1,2.2	
	Lecture notes, sections 2.2,2.3	
Week 4	Asst 1: p.38, question 4 ; p.71, questions 2(d), 4(c) ; p. 77, question 2(a) ; p.78, question 6 ; p.81, questions 1(b),(d)	Assignment 1 (March 16th)
Week 5	Lecture notes, sections 3.1,3.2	
Week 6	Lecture notes, sections 3.3,3.4	
	Lecture notes, section 4.1	
Week 7	Asst 2: p.82, questions 5 & 7 ; p.109, question 11 ; p.112, questions 8 & 9 ; p.100, question 2	Assignment 2 (April 6th)
Mid semester break (three weeks)		
	Lecture notes, sections 4.2,4.3	
Week 8	Asst 3: p.114, question 1 ; p.115, question 3 ; p.135, question 3 ; p.136, question 8 ; p.140, question 1	Assignment 3 (May 4th)
Week 9	Lecture notes, sections 4.4,4.5	
	Lecture notes, sections 5.1,5.2	
Week 10	Asst 4: p.170, question 1 ; p.171, question 7 ; p.178, question 1 ; p.188, question 4	Assignment 4 (May 18th)
Week 11	Lecture notes, sections 5.3,5.4	
	Lecture notes, sections 6.1,6.2	
Week 12	Asst 5: p.196, question 5 ; p.197, questions 8 & 9 ; p.206, question 7 ; p.220, question 3 & 5 ;	Assignment 5 (June 1st)
Week 13	Lecture notes, section 6.3	Assignment 6

Week	Topics/events (see introduction and assessment)	Assessment due
	Asst 6: p.239, question 2(a),(c),(d) ; p.243, question 1 ; p.248, question 3 ; p.267, questions 1, 2 & 8 ; p. 290, questions 1 & 2	(June 8th)
Week 14	Examination period commences	

UNEonline

UNEonline is UNE's online teaching system. As a current student you have access to the student portal myUNE, through which you can access your online units, manage your enrolment, change personal information and access many useful functions. Log in to myUNE from the UNE homepage using your UNE username and password. All units have an online site that may include features such as a message board, a discussion forum and electronic downloads of teaching material.

Accessing the online site for this unit

To access the online site for this unit, log in to myUNE from the UNE homepage using your UNE username and password. Go to the myStudy tab. A list of the units in which you are currently enrolled will be displayed in the myUnits and Services table. When the online site for one of your units becomes available, a UNEonline column will be displayed. You can access the online unit by clicking on the icon in this column. Please note that most online units will not be available until the first day of teaching.

If you have any problems related to accessing myUNE or the online site for your unit, contact the IT Service Desk on 02 6773 5000, via [AskUNE](#) or by emailing servicedesk@une.edu.au.

List of usernames - disclaimer

Please note that your username within UNEonline appears as part of a list in some places. Only students enrolled in the unit have access to this list. Please contact your unit coordinator if you have any concerns.

General Information

Library services

What can the Library do for you?

Find out at http://www.une.edu.au/library/services/unit_guide.php. This guide provides easy pathways to UNE's vast online resources and shows how the Library can help you with your studies. You can borrow books, obtain copies of articles and exam papers, and request advice from librarians on search strategies and information tools to use.

Learning support

The Academic Skills Office (ASO) is UNE's learning support unit. The ASO has study skills advisors and a wealth of print and online resources to help you with your study skills development or problems.

ASO fact sheets

The ASO has developed a series of fact sheets that answer the questions most frequently asked by students. They can be found at <http://www.une.edu.au/tlc/aso/students/factsheets/>.

ASO discussion forum

If you would like to discuss specific issues related to study skills or academic writing with an advisor, or benefit from the questions other students ask, you can log on to the ASO Discussion Forum at <http://www.une.edu.au/tlc/aso/students/programs/tuneup/advisor.php>.

Key terms

A glossary of some of the key terms used to describe academic and administrative activities, roles and structures at UNE can be found at <http://www.une.edu.au/policies/pdf/glossarykeyterms.pdf>. It is very useful for understanding the terminology associated with your study.

Other Support at UNE

Other support services are available to assist you throughout the course of your studies. Some of these services are outlined below. For the full range of support services, go to <http://www.une.edu.au/for/current-students/> and follow the links.

Student Assist

Student Assist's support services include disability and special needs support, counselling, and career development. To see the range of services they offer, go to <http://www.une.edu.au/student-assist/>.

Aboriginal and Torres Strait Islander students

The Oorala Aboriginal Centre is a study support and advisory centre for internal and external Aboriginal and Torres Strait Islander students at UNE. To find out more about the support services Oorala offers, go to <http://www.une.edu.au/oorala/>.

International students

International Services provides support for international students at UNE. For more information about the services offered, go to <http://www.une.edu.au/elis>.

AskUNE

If you have questions that are not answered by this booklet, go to [AskUNE](#). At AskUNE you can find answers to many common enquiries or submit an enquiry of your own by clicking on the 'Contact Us' tab.