MATH236

Mathematics IIB

S2 Day 2019

Dept of Mathematics and Statistics

Contents

General Information

Unit convenor and teaching staff
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Credit points
3

Prerequisites
MATH235

Corequisites

Co-badged status

Unit description
This unit deals with two of the most fundamental concepts in analysis – complex analysis and vector analysis. Complex analysis is the study of complex-valued functions of complex variables. Two approaches to the study of complex-valued functions of one complex variable are discussed. The first of these, usually attributed to Riemann, is based on differentiation and involves pairs of partial differential equations called the Cauchy–Riemann equations. The second approach, usually attributed to Cauchy, is based on integration and depends on a fundamental theorem known nowadays as Cauchy's integral theorem. The concept of vector analysis provides the tools for modelling physical phenomena such as fluid flow, electromagnetic and other field-based theories. We consider vector fields and integrals over paths and surfaces, and develop an understanding of the famous integration theorems of Green, Stokes and Gauss. These theorems transform physical laws expressed in differential form to integral form.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;

evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;

analyze the main properties of vector fields using the gradient, divergence and curl operators;

evaluate path, surface and volume integrals of vector fields;

apply the important theorems due to Green, Stokes and Gauss to physical applications.

General Assessment Information

HURDLES: This unit has no hurdle requirements.

ATTENDANCE and PARTICIPATION: Please contact the unit convenor as soon as possible if you have difficulty attending and participating in any classes. There may be alternatives available to make up the work. If there are circumstances that mean you miss a class, you can apply for a Special Consideration.

ASSIGNMENT SUBMISSION: Assignment submission will be online through the iLearn page.

Submit assignments online via the appropriate assignment link on the iLearn page. A personalised cover sheet is not required with online submissions. Read the submission statement carefully before accepting it as there are substantial penalties for making a false declaration.

- Assignment submission is via iLearn. You should upload this as a single scanned PDF file.
- Please note the quick guide on how to upload your assignments provided on the iLearn page.
- Please make sure that each page in your uploaded assignment corresponds to only one A4 page (do not upload an A3 page worth of content as an A4 page in landscape). If you are using an app like Clear Scanner, please make sure that the photos you are using are clear and shadow-free.
- It is your responsibility to make sure your assignment submission is legible.
- If there are technical obstructions to your submitting online, please email us to let us know.

You may submit as often as required prior to the due date/time. Please note that each submission will completely replace any previous submissions. It is in your interests to make

frequent submissions of your partially completed work as insurance against technical or other problems near the submission deadline.

LATE SUBMISSION: All assignments must be submitted by the official due date and time. No marks will be given to late work unless an extension has been granted following a successful application for Special Consideration. Please contact the unit convenor for advice as soon as you become aware that you may have difficulty meeting any of the assignment deadlines. It is in your interests to make frequent submissions of your partially completed work. Note that later submissions completely replace any earlier submission, and so only the final submission made before the due date will be marked.

FINAL EXAM POLICY: You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period. The only excuse for not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these special circumstances, you may apply for special consideration via ask.mq.edu.au.

SUPPLEMENTARY EXAMINATIONS:

IMPORTANT: If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. If you apply for special consideration, you must give the supplementary examination priority over any other pre-existing commitments, as such commitments will not usually be considered an acceptable basis for a second application for special consideration. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (https://bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification sometime in the week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	15%	No	Week 6
Class Test	20%	No	Week 8
Assignment 2	15%	No	Week 12
Final Exam	50%	No	Exam period

Assignment 1

Due: **Week 6**
Weighting: **15%**

The assignments will contain questions based on both halves of the unit, and should be submitted through iLearn.

On successful completion you will be able to:

- analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
- analyze the main properties of vector fields using the gradient, divergence and curl operators;
- evaluate path, surface and volume integrals of vector fields;
- apply the important theorems due to Green, Stokes and Gauss to physical applications.

Class Test

Due: **Week 8**
Weighting: **20%**

The Mid-Term Test will be 45 minutes. It will be held in Week 8, and will cover the material presented in lectures and SGTA's in Week 1 to Week 7 inclusive.

The test will consist of questions very similar to questions on the Week 2 - Week 7 SGTA sheets.

On successful completion you will be able to:

- analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
- analyze the main properties of vector fields using the gradient, divergence and curl operators;
- evaluate path, surface and volume integrals of vector fields;
- apply the important theorems due to Green, Stokes and Gauss to physical applications.

Assignment 2

Due: **Week 12**
Weighting: **15%**

The assignments will contain questions based on both halves of the unit, and should be submitted through iLearn.

On successful completion you will be able to:

- analyze the main properties of functions of a single complex variable, such as analyticity

and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
- analyze the main properties of vector fields using the gradient, divergence and curl operators;
- evaluate path, surface and volume integrals of vector fields;
- apply the important theorems due to Green, Stokes and Gauss to physical applications.

Final Exam

Due: **Exam period**
Weighting: **50%**

All parts of the unit may be tested in the final exam.

On successful completion you will be able to:
- analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
- analyze the main properties of vector fields using the gradient, divergence and curl operators;
- evaluate path, surface and volume integrals of vector fields;
- apply the important theorems due to Green, Stokes and Gauss to physical applications.

Delivery and Resources

Classes

Lectures: you should attend two hours of each lecture stream each week, making a total of four hours per week.

Small Group Teaching Activity (SGTA): you should attend and participate in one SGTA each week.

Required and Recommended Texts and/or Materials

The online notes are intended primarily as a source of reference. These are not intended to be treated as the only source for learning.

The following texts provide useful references for various sections of the course:

- Churchill and Brown; *Complex variables and applications*, (McGraw–Hill) library call number QA331 .C524

- Marsden and Tromba; *Vector Calculus*, (Wiley) library call number QA303 .M338

Many other similar texts are available in the Library, and your lecturers can give other recommendations.

Unit Schedule

The following table gives an approximate timetable for the topics covered week-by-week.

Week	Vector Calculus	Complex Analysis	Assessment
1	Paths in R^2 and R^3	Complex plane	
2	Vector fields	Complex functions	
3	Div, Grad, Curl	Analytic functions	
4	Path Integrals	Complex logarithm	
5	Conservative fields	Complex integration	
6	Potentials	Cauchy's integral theorem	Assignment 1
7	Surfaces	Cauchy's integral formula	
8	Surface integrals	Taylor's theorem	Class test
9	Flux integrals	Isolated zeroes theorem	
10	Green's theorem	Laurent series	
11	Stokes' theorem	Essential singularities	
12	Gauss' theorem	Cauchy's residue theorem	Assignment 2
13	Revision	Revision	

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy

- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
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- apply the important theorems due to Green, Stokes and Gauss to physical applications.

Assessment tasks

- Assignment 1
- Class Test
- Assignment 2
- Final Exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to

have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
- analyze the main properties of vector fields using the gradient, divergence and curl operators;
- evaluate path, surface and volume integrals of vector fields;
- apply the important theorems due to Green, Stokes and Gauss to physical applications.

Assessment tasks

- Assignment 1
- Class Test
- Assignment 2
- Final Exam

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- analyze the main properties of functions of a single complex variable, such as analyticity and singularity structure;
- evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem;
- analyze the main properties of vector fields using the gradient, divergence and curl operators;
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Assessment tasks

- Assignment 1

- Assignment 2
- Final Exam