MATH2020

Vector Calculus and Complex Analysis

Session 2, In person-scheduled-weekday, North Ryde 2022

School of Mathematical and Physical Sciences

Contents

General Information

Unit convenor and teaching staff
Paul Bryan
paul.bryan@mq.edu.au

Ross Moore
ross.moore@mq.edu.au

Credit points
10

Prerequisites
MATH2010 or MATH2055 or MATH235

Corequisites

Co-badged status

Unit description
The topics covered in this unit lay the foundations for further study in modern areas of mathematics (such as partial differential equations, fluid mechanics, and mathematical biology). This unit builds on the first year single variable calculus units by extending calculus to several variables, and focuses primarily on integration techniques for complex functions and vector fields. Complex analysis is the study of complex-valued functions of complex variables. The main properties of complex functions of a single complex variable will be presented, including the important concepts of analyticity and singularity structure. This will be followed by a treatment of Cauchy's theorem and the residue theorem to evaluate contour integrals of complex functions around various curves in the complex plane. Vector calculus is the study of vector fields in two and three dimensions, and facilitates the modelling of a variety of physical phenomena, for example in fluid mechanics and electromagnetism. By introducing the gradient, divergence and curl operators, the main properties of vector fields can be analysed. A variety of integrals of vector fields over paths, surfaces and volumes will be performed, and the application of three important integral theorems of vector calculus due to Green, Stokes and Gauss to evaluate these integrals will be demonstrated.

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:

ULO1: Analyse the main properties of functions of a single complex variable, such as analyticity and singularity structure.
ULO2: Evaluate contour integrals of complex functions by applying Cauchy's theorem and the residue theorem.
ULO3: Analyse the main properties of vector fields using the gradient, divergence and curl operators.
ULO4: Evaluate path, surface and volume integrals of vector fields.
ULO5: Apply the important theorems due to Green, Stokes and Gauss to physical applications.

General Assessment Information

Late Assessment Submission Penalty

From 1 July 2022, Students enrolled in Session based units with written assessments will have the following late penalty applied. Please see https://students.mq.edu.au/study/assessment-exams/assessments for more information.

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark) will be applied each day a written assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. Submission time for all written assessments is set at 11:55 pm. A 1-hour grace period is provided to students who experience a technical concern.

For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, students need to submit an application for Special Consideration.

Assessments where Late Submissions will be accepted

In this unit, late submissions will be accepted as follows:

Assignment 1, Assignment 2 – YES, Standard Late Penalty applies Test 1, Test 2, Final Exam - NO, unless Special Consideration is granted

Assessment Tasks

Name	Weighting	Hurdle	Due
Test 2 (Online)	15%	No	Week 10
Final exam	50%	No	Examination Period
Assignment 2	10%	No	Week 12
Assignment 1	10%	No	Week 7

Name	Weighting	Hurdle	Due
Test 1 (Online)	15%	No	Week 4

Test 2 (Online)

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 10 hours
Due: **Week 10**
Weighting: **15%**

Online test

On successful completion you will be able to:

- Analyse 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.
- Analyse 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

Assessment Type [1]: Examination
Indicative Time on Task [2]: 15 hours
Due: **Examination Period**
Weighting: **50%**

Summative examination, held during the university examination period.

On successful completion you will be able to:

- Analyse 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.

- Analyse 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

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 10 hours
Due: **Week 12**
Weighting: **10%**

The assignments reinforce and build on material from lectures, and involve calculations and explanations.

On successful completion you will be able to:

- Analyse 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.
- Analyse 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 1

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 10 hours
Due: **Week 7**
Weighting: **10%**

The assignments reinforce and build on material from lectures, and involve calculations and explanations.

On successful completion you will be able to:

- Analyse 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.
- Analyse 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.

Test 1 (Online)

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 10 hours
Due: **Week 4**
Weighting: **15%**

Online test

On successful completion you will be able to:

- Analyse 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.
- Analyse 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.

---

[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

Classes

Lectures: there 2 x 1hr lectures and 1 x 2hr SGTA each week.

Unit Schedule

Vector Calculus

Week	Topic	Assessment
1	Differentiation, curves, vector fields	
2	Line integrals	
3	Green's theorem, Surfaces	
4	Surface integrals,flux	Test 1
5	Divergence Theorem, Kelvin-Stokes' Theorem	
6	Review and catch up	

Complex Analysis

Week	Topic	Assessment
7	Intro. to Complex Analysis, Complex Functions	Assignment 1
8	Analytic Functions, Complex Logarithm	
9	(Monday Holiday) Complex Integration	
10	Cauchy's Integral Theorem, Cauchy's Integral Formula	Test 2
11	Taylor's Theorem, Laurent Series	
12	Isolated Zeros, Isolated Singularities	Assignment 2
13	Cauchy's Residue Theorem Review	

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). 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
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

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

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.edu.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/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

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

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

The Writing Centre

The Writing Centre provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support
- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues

Student Enquiries

Got a question? Ask us via AskMQ, or contact Service Connect.

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.