



MATH2020

Vector Calculus and Complex Analysis

Session 2, In person-scheduled-weekday, North Ryde 2024

School of Mathematical and Physical Sciences

Contents

<u>General Information</u>	2
<u>Learning Outcomes</u>	3
<u>General Assessment Information</u>	3
<u>Assessment Tasks</u>	4
<u>Delivery and Resources</u>	7
<u>Unit Schedule</u>	7
<u>Policies and Procedures</u>	7

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General Information

Unit convenor and teaching staff

Paul Bryan

paul.bryan@mq.edu.au

Frank Valckenborgh

frank.valckenborgh@mq.edu.au

Frank Valckenborgh

frank.valckenborgh@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

Requirements to Pass This Unit

To pass this unit, you must achieve a total mark equal to or greater than 50%.

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation 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. The submission time for all uploaded assessments is 11:55 pm. A 1-hour grace period will be provided to students who experience a technical concern. For any late submission of timesensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration.

Assessments where Late Submissions will be accepted

- Tests - NO, unless Special Consideration is Granted
- Assignments - YES, Standard Late Penalty applies

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.

Written Assessments/Quizzes/Tests: If you experience circumstances or events that affect your ability to complete the written assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 2	10%	No	Week 12
Final exam	50%	No	Exam Period
Test 2	15%	No	Week 10
Assignment 1	10%	No	Week 7
Test 1	15%	No	Week 4

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.

Final exam

Assessment Type ¹: Examination

Indicative Time on Task ²: 15 hours

Due: **Exam 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.

Test 2

Assessment Type ¹: Quiz/Test

Indicative Time on Task ²: 10 hours

Due: **Week 10**

Weighting: **15%**

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.

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

Assessment Type ¹: Quiz/Test

Indicative Time on Task ²: 10 hours

Due: **Week 4**

Weighting: **15%**

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

Delivery

- 2 x 1hr lectures/week
- 1 x 2h SGTA/week

Resources

Vector Calculus

- **Main reference:** [Calculus \(OpenStax\) Vector Calculus](#)
- [Paul's Online Notes](#) (not Paul Bryan!)
- Marsden and Tromba; *Vector Calculus*, (Wiley) library call number [QA303 .M338](#)

Complex Analysis

- [Complex Variables with Applications \(Orloff\)](#)
- Churchill and Brown; *Complex variables and applications*, (McGraw–Hill) library call number [QA331 .C524](#)
- [Complex Analysis A Visual and Interactive Introduction](#) by Juan Carlos Ponce Campuzano
- Visual Complex Analysis; Tristan Needham. (hardcopy: [Amazon](#)) ([free PDF](#))

Applets for visualising Complex functions

- Domain colouring: https://complex-analysis.com/content/domain_coloring.html
- Analytic Landscapes https://complex-analysis.com/content/analytic_landscapes.html

Unit Schedule

Weeks 1 - 6: Vector Calculus

Weeks 7-12: Complex Analysis

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) (<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) (<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 Advocacy](#) provides independent advice on MQ policies, procedures, and processes

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.

Unit information based on version 2024.02 of the [Handbook](#)