MATH2020

Mathematical Modelling IIB

Session 2, Special circumstance 2020

Department of Mathematics and Statistics

Contents

Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

Notice

As part of Phase 3 of our return to campus plan, most units will now run tutorials, seminars and other small group learning activities on campus for the second half-year, while keeping an online version available for those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face and online activities for your unit, please go to timetable viewer. To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff
Convenor, Lecturer.
Ross Moore
ross.moore@mq.edu.au
Contact via Email
12 Wally's Walk 734
Thurs 10-12 or by appointment.

Lecturer
Paul Bryan
paul.bryan@mq.edu.au
Contact via Email
12 Wally's Walk 617
See iLearn for consultation hours

Frank Schoenig
frank.schoenig@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

HURDLES: This unit has no hurdle requirements.

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
Mid-semester test	20%	No	Week 8
Assignment 1	15%	No	Week 6
Assignment 2	15%	No	Week 12
Final exam	50%	No	Exam period

Mid-semester test

Assessment Type [1]: Quiz/Test
Indicative Time on Task [2]: 8 hours
Due: **Week 8**
Weighting: **20%**

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.

Assignment 1

Assessment Type [1]: Problem set
Indicative Time on Task [2]: 8 hours
Due: **Week 6**
Weighting: **15%**

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 functuions 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]: 8 hours
Due: **Week 12**
Weighting: **15%**

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.

---

[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 2hr lectures each week (one in each of the two lecture streams), making a total of four hours per week.

Small Group Teaching Activity (SGTA): there is a 1x1hr SGTA class each week, held at various times.

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 singuarities	
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.)

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 help you improve your marks and take control of your study.

- Getting help with your assignment
- Workshops
- StudyWise
- 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

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.

Changes from Previous Offering

This year we will use coloured scientific graphics as a means to represent complex functions and their significant features. Although only optional, students will be encouraged to download free reader software to be better able to explore such graphics for themselves.