THE UNIVERSITY OF SYDNEY

MATH1921 : Calculus of One Variable (Advanced)

Semester 1, 2019 | 3 Credit points | Mode of delivery: Normal (lecture/lab/tutorial) day | Unit type: Standard

Coordinator: A/Prof Sharon Stephen

Faculty of Science , School of Mathematics and Statistics

Unit description

Calculus is a discipline of mathematics that finds profound applications in science, engineering, and economics. This unit investigates differential calculus and integral calculus of one variable and the diverse applications of this theory. Emphasis is given both to the theoretical and foundational aspects of the subject, as well as developing the valuable skill of applying the mathematical theory to solve practical problems. Topics covered in this unit of study include complex numbers, functions of a single variable, limits and continuity, differentiation, optimization, Taylor polynomials, Taylor's Theorem, Taylor series, Riemann sums, and Riemann integrals. Additional theoretical topics included in this advanced unit include the Intermediate Value Theorem, Rolle's Theorem, and the Mean Value Theorem.

Prohibitions: MATH1001 or MATH1011 or MATH1906 or ENVX1001 or MATH1901 or MATH1021 or MATH1931

Pre-requisites: NSW HSC 2 unit Mathematics or equivalent or a credit or above in MATH1111

Co-requisites: None

Assumed knowledge: HSC Mathematics Extension 2 or equivalent.

Unit aims

The unit of study begins with a discussion of complex numbers. In particular an in-depth discussion of the complex exponential function will be provided. Next, the familiar terminology for functions gets an upgrade. Then the main theme of the unit is introduced, namely, the concept of a limit. Limits will be treated rigorously (the “epsilon-delta" definition) and rules will be developed to calculate and manipulate limits. With the concept of limit in place, one can now study functions with nice properties such as continuity or differentiability and derive consequences of these properties. In particular, a strong form of l'Hopital's rule for calculating certain types of limits will be proved. The next part of the unit deals with the powerful theory of Taylor polynomials and Taylor series of standard functions. The final part of the unit introduces the Riemann integral via Riemann sums. Application of Riemann sums include the derivation of formulas for arc length, volumes and surfaces of revolution. The theory of integrals and derivatives is then provided via the Fundamental Theorem of Calculus. The final part of the unit is a discussion of integration methods and improper integrals.

Learning outcomes

At the completion of this unit, you should be able to:

LO1. Apply mathematical logic and rigor to solving problems and express mathematical ideas coherently in written and oral form.

LO2. Demonstrate fluency in manipulating complex numbers, functions of one or more variables, inverse functions, limits, derivatives, maxima and minima, and polynomial approximations

LO3. Understand and know how to use the theorems that apply specifically to continuous functions (intermediate value theorem, extreme value theorem) and to differentiable functions (chain rule, Rolle's theorem, mean value theorem, L’Hopital's rule).

LO4. Understand and be able to work with Taylor polynomials, remainder estimates and Taylor series.

LO5. Appreciate the significance of integral calculus, and in particular appreciate the powerful interplay between integral and differential calculus via the Fundamental Theorem of Calculus.

LO6. Apply integration methods including integration by substitution, integration by parts, partial fractions, proficiently without too much guidance.

LO7. Derive and use the formulas for arc length, volumes of revolution and surface area of revolution.

LO8. Deal with improper integrals, including the use of comparison theorems.

Graduate qualities

The graduate qualities are the qualities and skills that all University of Sydney graduates must demonstrate on successful completion of an award course. As a future Sydney graduate, the set of qualities have been designed to equip you for the contemporary world. For more information go to sydney.edu.au/students/graduate-qualities

GQ1 Depth of disciplinary expertise

GQ2 Critical thinking and problem solving

GQ3 Communication (oral and written)

GQ4 Information & digital literacy

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GQ5 Inventiveness
GQ6 Cultural competence
GQ7 Interdisciplinary effectiveness
GQ8 Integrated professional, ethical and personal identity
GQ9 Influence

Study commitment

For a 3 credit point unit, this equates to roughly 60-75 hours of student effort in total.

Teaching staff and contact details

Coordinator: A/Prof Sharon Stephen, sharon.stephen@sydney.edu.au
Teaching staff: A/Prof Daniel Daners, daniel.daners@sydney.edu.au

Administrative and professional staff: MATH1921@sydney.edu.au

Weekly schedule

Week	Topic	Learning activity type	Learning outcomes
Week 1	Complex numbers in Cartesian and polar form. Complex powers and De Moivre's Theorem.	Lecture	
Week 2	nth roots. The complex exponential function. Representing complex functions.	Lecture	
Week 3	Injective and bijective functions. Inverse functions. Hyperbolic functions.	Lecture	
Week 4	Limits and the limit laws.	Lecture	
Week 5	Continuity. Intermediate Value Theorem.	Lecture	
Week 6	Differentiability. Rolle's Theorem and the Mean Value Theorem.	Lecture	
Week 7	Cauchy's Mean Value Theorem and L'Hopital's Rule.	Lecture	
Week 8	Taylor polynomials with remainder. Taylor series of standard functions.	Lecture	
Week 9	Evaluation of Riemann sums. Definition of the Riemann integral.	Lecture	
Week 10	Fundamental Theorem of Calculus. Functions defined by integrals.	Lecture	
Week 11	Applications of Riemann sums and integrals: volumes, arc lengths, volumes of revolution, surface area of revolution.	Lecture	
Week 12	Improper integrals. Integrals of unbounded functions. Integrals over unbounded intervals. Comparison tests. p-integrals.	Lecture	
Week 13	Revision / Spill-over	Lecture	

Assessments

Assessment title	Assessment category	Assessment type	Description of assessment type	Individual or group	Length / duration	Weight	Due date & time	Closing date	Learning outcomes
Assignment 1	Submitted work	Assignment		Individual		5%	Thu 21 Mar 11:59pm	Thu 28 Mar 11:59pm	
Quiz 1	In-class assessment	Tutorial quiz, small test or		Individual		10%	Week 7	Week 7	

Assessment title	Assessment category	Assessment type	Description of assessment type	Individual or group	Length / duration	Weight	Due date & time	Closing date	Learning outcomes
		online task							
Assignment 2	Submitted work	Assignment		Individual		5%	Thu 2 May 11:59pm	Thu 9 May 11:59pm	
Quiz 2	In-class assessment	Tutorial quiz, small test or online task		Individual		10%	Week 12	Week 12	
Final Exam	Exam	Final exam		Individual	1.5 hours	70%	Final Exam Period		

Overview of assessments

Below are brief assessment details. Further information can be found in the Canvas site for this unit.

- **Assignments:** There are two assignments, which must be submitted electronically, as PDF files only, via Canvas by the deadline. Note that your assignment will not be marked if it is illegible or if it is submitted sideways or upside down. It is your responsibility to check that your assignment has been submitted correctly.
- **Quizzes:** Quizzes will be held during tutorials. You must sit for the quiz during the tutorial in which you are enrolled, unless you have permission from the Student Services Office, issued only for verifiable reasons. Otherwise, your quiz mark may not be recorded. Quizzes will only be returned in the tutorial you sat the quiz and must be collected by week 13. The better mark principle will be used for the quizzes so do not submit an application for Special Consideration or Special Arrangements if you miss a quiz. The better mark principle means that for each quiz, the quiz counts if and only if it is better than or equal to your exam mark. If your quiz mark is less than your exam mark, the exam mark will be used for that portion of your assessment instead.
- **Examination:** Further information about the exam will be made available at a later date on Canvas.

Readings

- Course Notes for MATH1921 Calculus of One Variable (Advanced) are available for purchase from Kopystop, 55 Mountain St, Broadway.

Other resources

- **Tutorials:** Tutorials start in week 2. You should attend the tutorial given on your personal timetable. Attendance at tutorials will be recorded. Your attendance will not be recorded unless you attend the tutorial in which you are enrolled. If you are absent from a tutorial do not apply for Special Consideration or Special Arrangement, since there is no assessment associated with the missed tutorial.
- **Tutorial and exercise sheets:** The question sheets for a given week will be available on the MATH1921 webpage. Solutions to tutorial exercises for week n will usually be posted on the web by the afternoon of the Friday of week n.
- **Ed Discussion forum:** https://edstem.org

Late penalties

All assignments must be submitted by the due date. Students are expected to manage their time and to prioritise tasks to meet deadlines. Assessment items submitted after the due date without an approved extension using a special consideration or special arrangement form or request will incur penalties.

If you encounter a problem submitting your work on time, you may be able to arrange a simple extension. A simple extension is an informal arrangement between you and your unit of study coordinator. You may be able to receive an extension of up to two working days for non-examination tasks, as outlined in clause 66A of the Coursework Policy 2014. If you need an extension for a longer period, you may be eligible to apply for special consideration. sydney.edu.au/students/simple-extensions

Special consideration

A special consideration application can be made for short-term circumstances beyond your control, such as illness, injury or

misadventure, which affect your preparation or performance in an assessment. sydney.edu.au/special-consideration

Assessment grading

The University awards common result grades, set out in the Coursework Policy 2014 (Schedule 1).
As a general guide, a High distinction indicates work of an exceptional standard, a Distinction a very high standard, a credit a good standard, and a pass an acceptable standard.

Result name	Mark range	Description
High distinction	85 - 100	Representing complete or close to complete mastery of the material.
Distinction	75 - 84	Representing excellence, but substantially less than complete mastery.
Credit	65 - 74	Representing a creditable performance that goes beyond routine knowledge and understanding, but less than excellence.
Pass	50 - 64	Representing at least routine knowledge and understanding over a spectrum of topics and important ideas and concepts in the course.
Fail	0 - 49	When you don't meet the learning outcomes of the unit to a satisfactory standard.

For more information see: sydney.edu.au/students/guide-to-grades

Educational integrity

While the University is aware that the vast majority of students and staff act ethically and honestly, it is opposed to and will not tolerate academic dishonesty or plagiarism and will treat all allegations of dishonesty seriously.

All written assignments submitted in this unit of study will be submitted to the similarity detecting software program known as Turnitin. Turnitin searches for matches between text in your written assessment task and text sourced from the Internet, published works and assignments that have previously been submitted to Turnitin. If such matches indicate evidence of plagiarism to your teacher, they are required to report your work for further investigation.

Further information on academic honesty and the resources available to all students can be found on the Academic Integrity page of the current students' website: sydney.edu.au/students/academic-integrity

Work, health and safety requirements for this unit

We are governed by the Work Health and Safety Act 2011, Work Health and Safety Regulation 2011 and Codes of Practice. Penalties for non-compliance have increased. Everyone has a responsibility for health and safety at work. The University's Work Health and Safety policy explains the responsibilities and expectations of workers and others, and the procedures for managing WHS risks associated with University activities.

General Laboratory Safety Rules

- No eating or drinking is allowed in any laboratory under any circumstances
- A laboratory coat and closed-toe shoes are mandatory
- Follow safety instructions in your manual and posted in laboratories
- In case of fire, follow instructions posted outside the laboratory door
- First aid kits, eye wash and fire extinguishers are located in or immediately outside each laboratory
- As a precautionary measure, it is recommended that you have a current tetanus immunisation. This can be obtained from University Health Service: unihealth.usyd.edu.au/

Other requirements for this unit

- Please check the Canvas site for this unit for any information.

Site visit guidelines

- There are no site visit guidelines for this unit.

Additional costs

- There are no additional costs for this unit.

Closing the loop

- Please check the Canvas site for this unit for any information.

Links to policies and other information for students

- Student administration: sydney.edu.au/student-administration
- Wellbeing and support: sydney.edu.au/students/health-wellbeing
- Study resources: sydney.edu.au/students/learning-services
- Expectations of student conduct: sydney.edu.au/student-responsibilities
- Learning and Teaching Policy: sydney.edu.au/policies/
- Academic appeals: sydney.edu.au/students/academic-appeals
- Libraries: sydney.edu.au/students/libraries

Other relevant information

- Please check the Canvas site for this unit for any information.

Other links

- Science student portal: canvas.sydney.edu.au/courses/7114
- Mathematics and Statistics student portal: canvas.sydney.edu.au/courses/7913