MATH1021 : Calculus of One Variable

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, optimisation, Taylor polynomials, Taylor's Theorem, Taylor series, Riemann sums, and Riemann integrals.

Prohibitions: MATH1011 or MATH1901 or MATH1906 or MATH1111 or ENVX1001 or MATH1001 or MATH1921 or MATH1931

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

Co-requisites: None


Unit aims

The unit aims to improve your ability to think logically, analytically, and abstractly, and to enhance your problem-solving skills. In addition, this unit will provide students with a solid foundation for further studies in mathematics and/or other scientific disciplines.

Learning outcomes

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

LO1. Apply mathematical logic and rigour to solving problems.
LO2. Read and write basic set notation.
LO3. Apply arithmetic operations with complex numbers in Cartesian, polar, and exponential form.
LO4. Use de Moivre’s theorem to find powers and roots of complex numbers.
LO5. Solve simple polynomial equations involving complex numbers.
LO6. Apply an intuitive understanding of a limit and knowledge of basic limit laws to calculate the limits of functions.
LO7. Use the differential of a function to calculate critical points and apply them to optimize functions of one variable.
LO8. Find inverse functions.
LO9. Use L'Hopital's rule to find limits of indeterminate forms.
LO10. Find Taylor polynomials and the Taylor series expansion of a function.
LO11. Approximate definite integrals by finite sums and vice versa.
LO12. Express areas, and volumes of revolution, as definite integrals.
LO13. Apply standard integration techniques to find anti-derivatives and definite integrals.
LO14. Determine properties of a function defined by an integral using the graph of its integrand.
LO15. Express mathematical ideas and arguments coherently in written form.

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
GQ5 Inventiveness
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: Prof. Ben Goldys, benjamin.goldys@sydney.edu.au
Dr. Behrouz Taji, behrouz.taji@sydney.edu.au,
Dr. Fernando Viera, fernando@maths.usyd.edu.au
Administrative and professional staff: MATH1021@sydney.edu.au

Weekly schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Learning activity type</th>
<th>Learning outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>Set notation, the real number line. Complex numbers in Cartesian form. Complex plane, modulus.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 2</td>
<td>Complex numbers in polar form. De Moivre’s Theorem. Complex powers and nth roots.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 3</td>
<td>Definition of $e^{i\theta}$ and $e^z$ for $z$ complex. Applications to trigonometry. Revision of domain and range of a function.</td>
<td>Lecture and tutorial</td>
<td></td>
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<tr>
<td>Week 4</td>
<td>Limits and continuity. Vertical and horizontal asymptotes.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 5</td>
<td>Differentiation and the chain rule. Implicit differentiation. Hyperbolic and inverse functions.</td>
<td>Lecture and tutorial</td>
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</tr>
<tr>
<td>Week 6</td>
<td>Optimizing and sketching functions of one variable. Linear approximations and differentials. L’Hospital’s rule</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 7</td>
<td>Taylor polynomials. The remainder term.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 8</td>
<td>Taylor series.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 9</td>
<td>Riemann sums. Definition of definite integral. Non-positive functions.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 10</td>
<td>Fundamental Theorem of Calculus (Parts 1 and 2). Functions defined by integrals. Natural logarithm and exponential functions.</td>
<td>Lecture and tutorial</td>
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<tr>
<td>Week 11</td>
<td>Integration by substitution. Integration by parts. Trigonometric substitution.</td>
<td>Lecture and tutorial</td>
<td></td>
</tr>
<tr>
<td>Week 12</td>
<td>Areas and volumes by slicing. The disk and shell methods.</td>
<td>Lecture and tutorial</td>
<td></td>
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<tr>
<td>Week 13</td>
<td>Revision.</td>
<td>Lecture and tutorial</td>
<td></td>
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Assessments

<table>
<thead>
<tr>
<th>Assessment title</th>
<th>Assessment category</th>
<th>Assessment type</th>
<th>Description of assessment type</th>
<th>Individual or group</th>
<th>Length / duration</th>
<th>Weight</th>
<th>Due date &amp; time</th>
<th>Closing date</th>
<th>Learning outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>Submitted work</td>
<td>Assignment</td>
<td>Individual</td>
<td>2.5%</td>
<td>Thu 21 Mar 11:59pm</td>
<td>Thu 28 Mar 11:59pm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quiz 1</td>
<td>In-class assessment</td>
<td>Tutorial quiz, small test or online task</td>
<td>Individual</td>
<td>15%</td>
<td>Mon 8- Wed 10 Apr</td>
<td>Wed 10 Apr</td>
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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.

- **Online quizzes:** There are twelve weekly online quizzes. Each online quiz consists of a set of randomized questions. The best 10 of your 12 quizzes will count, making each worth 1%. You cannot apply for special consideration for the quizzes. The better mark principle will apply for the total 10% - i.e. if your overall exam mark is higher, then your 10% for quizzes will come from your exam. The deadline for completion of each quiz is 11:59 pm Thursday (starting in week 2). We recommend that you follow the due dates outlined above to gain the most benefit from these quizzes.

- **Examination:** The weighting for the exam has been reduced from that shown in the Handbook to accommodate including of the online quizzes. Further information about the exam will be made available at a later date on the Canvas.

Readings

All readings for this unit can be accessed on the Library eReserve link available in the Canvas site for this unit.

- Course Notes for MATH1021 Calculus of One Variable 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 MATH1021 webpage. Solutions to tutorial exercises for week n will usually be posted on the web by the afternoon of the Friday of week n.
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/students/special-consideration-and-arrangements

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.

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

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/educational-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
- **Attendance Requirement:** Unless otherwise indicated, students are expected to attend a minimum of 80% of timetabled activities for a unit of study, unless granted exemption by the Associate Dean.

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/study/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/students/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