

MATH1023: Multivariable Calculus and Modelling

Semester 2, 2019 | 3 Credit points | Mode of delivery: Normal (lecture/lab/tutorial) day | Unit type: Standard

Coordinator: Sharon Stephen

Faculty of Science (SCIE), Mathematics and Statistics Academic Operations

Unit description

Calculus is a discipline of mathematics that finds profound applications in science, engineering, and economics. This unit investigates multivariable differential calculus and modelling. 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 mathematical modelling, first order differential equations, second order differential equations, systems of linear equations, visualisation in 2 and 3 dimensions, partial derivatives, directional derivatives, the gradient vector, and optimisation for functions of more than one variable.

Prohibitions: MATH1013 or MATH1903 or MATH1907 or MATH1003 or MATH1923 or MATH1933

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

Co-requisites : None

Assumed knowledge: MATH1X21, HSC Mathematics Extension 1 or equivalent.

Unit aims

The aim of this unit is to advance the student's mathematical knowledge about Calculus and to show how it leads to a deeper understanding of natural phenomena. The content of this unit is divided in two broad topics. The first topic is the study of differential equations, how to solve them and how they act as mathematical models. The second topic is multi-variable Calculus, the extension of Calculus to functions of more than one variables which increases its applicability to new areas of scientific and technological interest.

Learning outcomes

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

- LO1. apply mathematical logic and rigor to solving problems
- LO2. express mathematical ideas and arguments coherently in written form
- LO3. set up differential equations which arise from mathematical models of interest to scientists and engineers
- LO4. understand the relationship between a first-order differential equation, its direction field, and its solution curves
- LO5. solve separable and first-order linear differential equations
- LO6. solve second-order homogeneous linear differential equations with constant coefficients
- LO7. calculate partial derivatives and understand their geometric significance
- LO8. find equations of tangent planes to surfaces
- LO9. calculate the directional derivative and gradient vector, and understand their physical significance.
- LO10. optimise functions of two or more variables

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.

Please see <https://sydney.edu.au/students/graduate-qualities.html>

Study commitment

- Typically, there is a minimum expectation of 1.5-2 hours of student effort per week per credit point for units of study offered over a full semester. For a 3 credit point unit, this equates to roughly 60-75 hours of student effort in total.

Teaching staff and contact details

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Teaching staff : Leo Tzou, leo.tzou@sydney.edu.au
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Administrative and professional staff: MATH1023@sydney.edu.au

Learning activities schedule

Week	Topic	Learning activity type	Learning outcomes
Week 1	Introduction to models and differential equations	Lecture	LO3, LO4
Week 2	Separable equations	Lecture and tutorial	LO5
Week 3	Applications of separable equations	Lecture and tutorial	LO3, LO5
Week 4	Linear differential equations	Lecture and tutorial	LO5
Week 5	Second-order differential equations	Lecture and tutorial	LO6
Week 6	Resonance and coupled differential equations	Lecture and tutorial	LO6
Week 7	Curves and surfaces in three-dimensional space	Lecture and tutorial	
Week 8	Partial derivatives and tangent planes	Lecture and tutorial	LO7, LO8
Week 9	Second-order partial derivatives and continuity	Lecture and tutorial	LO7
Week 10	Directional derivatives and the gradient vector	Lecture and tutorial	LO9
Week 11	Further applications of the partial derivative	Lecture and tutorial	LO9
Week 12	Optimizing functions of two variables	Lecture and tutorial	LO10
Week 13	Revision/further applications	Lecture and tutorial	LO4, LO5, LO6, LO7, LO8, LO9, LO10

Assessments

Assessment title	Assessment category	Assessment type	Assessment type description	Individual or group	Weight	Due date & time	Closing date	Length/duration	Learning outcomes
Assignment 1	Submitted work	Assignment	n/a	Individual	2.5%	Week 4 29 August 2019 11.59pm	08/09/19 23:59	n/a	LO1, LO2, LO5
Quiz 1 (using the better mark principle)	In-class assessment	Tutorial quiz, small test or online task	n/a	Individual	15%	Week 6		40 minutes	LO4, LO5
Assignment 2	Submitted work	Assignment	n/n	Individual	2.5%	Week 10 17 October 2019 11.59pm	27/10/19 23:59	n/a	LO1, LO2
Quiz 2 (using the better mark principle)	In-class assessment	Tutorial quiz, small test or online task	n/a	Individual	15%	Week 12		40 minutes	LO6, LO7, LO8, LO9
Final exam	Exam	Final exam	n/a	Individual	65%	Formal exam period		1.5 hours	LO1, LO2, LO3, LO4, LO5, LO6, LO7, LO8, LO9, LO10

Assessment summary

- **Final exam:** There is one examination of 1.5 hours' duration during the examination period at the end of Semester 2. Further information about the exam will be made available at a later date on the website.
- **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.
- **Assignments:** There are two assignments, which must be submitted electronically, as PDF files only, in Turnitin (an internet-based plagiarism-prevention service), via the Learning Management System (Canvas) website 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 (check that you can view each page). Late submissions will receive a penalty. Detailed information for each assessment can be found on Canvas.

Prescribed readings

- **Reference textbook:** James Stewart. *Calculus*. Cengage Learning. 7th Edition, International Edition, 2012, ISBN 978-0-538-49884-5 or 8th Edition, Metric Version, 2015, ISBN 978-1-305-26672-8. Available from the Co-op Bookshop.
- **Course notes:** *Course Notes for MATH1023 Multivariable Calculus and Modelling*. School of Mathematics and Statistics, University of Sydney, Sydney, NSW, Australia, 2019. Available from Kopystop.

Other resources

- **Tutorial and exercise sheets:** The question sheets for a given week will be available on the MATH1023 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

The [Assessment Procedures 2011](#) provide that any written work submitted after 11:59pm on the due date will be penalised by 5% of the maximum awardable mark for each calendar day after the due date. If the assessment is submitted more than ten calendar days late, a mark of zero will be awarded.

However, a unit of study may prohibit late submission or waive late penalties only if expressly stated below.

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.

If you are eligible for special consideration, you must submit an online application and supporting documents within three working days of the assessment, unless exceptional circumstances apply.

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 detection software known as Turnitin. Turnitin searches for matches between text in your written assessment task and text sourced from the Internet, published works and assignments previously submitted to Turnitin. If such matches indicate evidence of plagiarism or other forms of dishonesty to your teacher, they are required to report your work for further investigation.

Further information on academic honesty, academic dishonesty, and the resources available to all students can be found on the academic integrity pages on the current students website: <https://sydney.edu.au/students/academic-integrity.html>

Work, health and safety requirements

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.

Other requirements

- **Attendance:** Students are expected to attend a minimum of 80% of timetabled activities for a unit of study, unless granted exemption by the Associate Dean.
- **Tutorial attendance:** Tutorials (one per week) 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. While there is no penalty if 80% attendance is not met we strongly recommend you attend tutorials regularly to keep up with the material and to engage with the tutorial questions. Since there is no assessment associated with the tutorials do not submit an application for Special Consideration or Special Arrangements for missed tutorials.

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

No changes have been made since this unit was last offered.

Links to policies and other information for students

The following information and services are available to all students:

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

Other relevant information

More information can be found on Canvas.

Other links

Science student portal (canvas.sydney.edu.au/courses/7114)

Mathematics and Statistics student portal (canvas.sydney.edu.au/courses/7913)