THE UNIVERSITY OF SYDNEY
MATH2061 LINEAR MATHEMATICS and VECTOR CALCULUS
Unit of Study Information, Semester 1, 2019

MATH2061 VECTOR CALCULUS

Weeks 7–13

Web Site

The MATH2061 home page may be found by following links from Canvas or by going directly to

`http://www.maths.usyd.edu.au/u/UG/IM/MATH2061`

You should check the home page regularly, since important announcements relating to the unit will often be posted there. You should obtain the practice session questions, tutorial exercise sheets and assignment questions from this page, as they become available.
You should also check the Intermediate Mathematics web page

`http://www.maths.usyd.edu.au/u/UG/IM`

regularly, for any announcements relating to intermediate mathematics in general.
Email enquiries specific to this unit should be sent to
MATH2061@sydney.edu.au.

Lectures

The Vector Calculus lectures start on Monday in Week 7, and finish on Tuesday in Week 13. (The last lecture will most likely be revision or a past exam paper.)
There are two different lecture streams. You should attend the lecture stream (three hours per week) shown on your personal timetable.

Times	Locations	Lecturer
Stream 1: 8:00 am Mon/Tue/Wed	ABE Business School, Carslaw 159, ABE	Kwok-Kun Kwong
Stream 2: 1:00 pm Mon/Tue/Wed	Chemistry LT3	Alexander Fish

Practice sessions

You should attend the practice session shown on your personal timetable. Practice sessions run for 7 weeks, starting in week 7. The examples to be discussed in the practice session in week n will be posted on the web by Monday of week n. You should print out the examples and take them with you to the practice class.

Tutorials
Vector calculus tutorials (one per week) start in week 8, and run for 6 weeks. The final tutorial for this module will be in week 13.
Attendance at tutorials is essential as your PREPARATION for the tutorials will contribute to your assessment.
You must attend the tutorial given on your personal timetable, since your preparation mark cannot be recorded in a tutorial in which you are not enrolled.
Tutorial sheets may be downloaded from the MATH2061 home page on the web.
Solutions to week n tutorial questions will be posted on the web by Friday of week n.

Consultation times
Lecturers are available for consultation as follows:

Times	Locations	Lecturer
Wed, 2.10-3.10pm	Carslaw 712	Alexander Fish
Mon, 9.10-10.10am	Carslaw 490	Kwok-Kun Kwong

Textbook
The text for this module is:
Course Notes for MATH2061 Vector Calculus by S Britton and K-G Choo,
available from Kopystop, 55 Mountain Street, Broadway.

It is also recommended that you have *"the little blue book"*, if copies are available from the Co-op Bookshop on campus.
This is a compact reference book containing a summary of information from first year mathematics which is essential for many second-year mathematics courses.

Reference books
Kreyszig, E., *Advanced Engineering Mathematics*, 7^{th} or 8^{th} edition, Wiley.
Stewart, J., *Calculus*, 4^{th} or 5^{th} edition, Brooks/Cole.

Assessment
Your final raw mark for the Vector Calculus module will be calculated as the sum of your marks for the examination (60%), the quiz (30%), the assignment (5%) and tutorial preparation (5%).
For the unit of study MATH2061 the final mark will be the sum of the marks for the Linear Mathematics module and the Vector Calculus module divided by two.

Examination – worth 60%.
There will be an examination at the end of Semester 1. More information relating to the exam will be provided later in the semester.

Assessment (continued)

Quiz – worth 30%.

The quiz will be held during your practice session on **Thursday in Week 13**.

Assignment – worth 5%.

One assignment will be marked, and will be worth 5% of your final raw mark. The assignment will be due on **Friday in Week 11**. Please note that the maximum possible extension for the assignment is 7 days (including the weekend).

The handwritten assignment must be scanned/imaged and submitted in PDF format online via Canvas (https://canvas.sydney.edu.au/) with Turnitin. Please ensure your submitted pdf is legible and **keep your original handwritten version**.

Tutorial Preparation Mark – worth 5%.

Rolls will be kept in tutorials, and you will receive one mark for each tutorial (up to a maximum of 5 marks) for preparation (that is, *reading the tutorial sheet in advance and attempting the preparatory questions and showing your work to the tutor*, not just attending). Your tutor will award the mark if he or she is satisfied that you have prepared appropriately.

WHAT IS VECTOR CALCULUS ABOUT?

Vector calculus is a powerful mathematical instrument for the study of various physical phenomena, and is indispensable as a tool in applied mathematics, engineering and science, and fundamental to many other areas of mathematics. We study the calculus of vector fields, which are functions that assign vectors to points in space.

A substantial part of the module will deal with integration in the plane and in space using vector methods. The module begins with a discussion of line integrals, which, for example, can be used to find work done by a force field in moving an object along a curve.

Next, we will discuss double and triple integrals, which can be used to evaluate area, volume, centroids, mass of a variable-density solid, and many other quantities. These ideas are then extended to surface integrals, which can be used to find the rate of fluid flow across a surface or flux of an electric field across a surface.

Connections between these types of integrals are given by the three important theorems of vector calculus, namely, Green's Theorem, Gauss' Theorem and Stokes' Theorem.

Assumed knowledge

The first year units MATH1001/1901 and MATH1002/1902 are both assumed knowledge for this unit and MATH1003/1903 is prerequisite. The vectors section of MATH1002/1902

is particularly important, as are the curve sketching and 3D surfaces from MATH1001/1901 and the integration techniques in MATH1003/1903.

Objectives

- Introduce the basic concepts of vector calculus.
- Demonstrate how abstract theory can be applied to concrete problems in science and engineering.
- Develop logical thinking and the ability to analyse mathematical arguments.

Outcomes

Students who successfully complete this course should:

- have extended (from first year) their knowledge of vectors in two and three dimensions, and of functions of several variables;
- be able to evaluate certain line integrals, double integrals, surface integrals and triple integrals;
- understand the physical and geometrical significance of these integrals;
- know how to use the important theorems of Green, Gauss and Stokes.

Intended weekly outline

- **Week 7:** Vector equations of lines and curves (revision). Arc length. Two types of line integrals. Work done by a force.
- **Week 8:** Vector fields. Grad and curl. Normals to surfaces. Conservative fields and potential functions.
- **Week 9:** Double integrals. Area, volume and mass. Div (divergence of a vector field). Green's theorem. Flux across a curve.
- **Week 10:** Green's theorem continued. Surface area. Surface integrals. Flux across a surface. Polar, cylindrical and spherical coordinates.
- **Week 11:** Triple integrals. Volume and mass revisited. Gauss' divergence theorem.
- **Week 12:** Triple integrals in cylindrical/spherical coordinates. Stokes' theorem. Connections between different types of integrals.
- **Week 13:** Revision.

For best results and maximum enjoyment in this unit of study, you should make every effort to attend all the lectures, practice sessions and tutorials.

Do as many problems as you can, and make sure you work through the solutions to the tutorial exercises each week.

Read over your own notes as well as the printed lecture notes, think deeply about the new definitions and ideas, and come with your questions to consultation times. We will be pleased to help you.