FACULTY OF SCIENCE
SCHOOL OF MATHEMATICS AND STATISTICS

MATH2019

ENGINEERING MATHEMATICS 2E

Term 1, 2019

MATH2019 — Course Outline

Information about the course

Course Authority: Milan Pahor.
Room RC-3091, Red Centre, Phone: 9385 7059. Email: `m.pahor@unsw.edu.au`

Stream 2 Lecturer: A/Prof William McLean.
Room RC-2085, Red Centre. Phone: 9385 7045. Email: `w.mclean@unsw.edu.au`

Credit: This course counts for 6 Units of Credit (6UOC). It is available only to students for whom it is specifically required as part of their program.

Prerequisites: MATH1231 or MATH1241 or MATH1251.

Exclusions: MATH2018, MATH2020, MATH2029, MATH2059, MATH2120 and MATH2130.

Lectures: There will be 6 hours of lectures per weeks. The regular lecture times are as follows.

Lecture Stream A			
Day	Time	Venue	Lecturer
Tuesday	10-12	Clancy Auditorium	McLean
Wednesday	9-11	Clancy Auditorium	McLean
Wednesday	13-14	Clancy Auditorium	Ellis
Friday	9-10	Clancy Auditorium	McLean

Lecture Stream B			
Day	Time	Venue	Lecturer
Monday	14-16	Mathews-A	Pahor
Thursday	9-11	CLB-7	Pahor
Friday	14-15	CLB-7	Ellis
Friday	15-16	CLB-7	Pahor

Due to public holidays in weeks 9 and 10, some catch-up lectures are scheduled for week 11.

Tutorials: Each student will attend five classroom tutorials and complete five online tutorials. The classroom and online tutorials alternate from week to week. Thus, depending on your tutorial group, you will either have classroom tutorials in odd weeks and online tutorials in even weeks, or else vice versa. Please consult your timetable for your tutorial times. **Tutorials start in Week 1.** The online tutorials are accessed via Moodle.

UNSW Moodle: Further information, skeleton lecture notes, and other material will be provided via Moodle.

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`https://moodle.telt.unsw.edu.au/login/index.php`

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Course aims

This course is designed to introduce students of Engineering to some mathematical tools and analytical reasoning that may be related to, and useful in, their future professions. The course features the mathematical foundations of some of the world's engineering advances. The course is not designed to be over-technical in terms of theoretical mathematics, rather it features a range of highly useful concepts that are at the core of applied mathematics.

Relation to other mathematics courses

This course builds naturally on the prerequisite first year mathematics course but more obviously contains applications relevant to Engineering problems.

Student Learning Outcomes

By the end of this course, students are expected to know and understand various ideas, concepts and methods from applied mathematics and how these ideas may be used in, or are connected to, various fields of engineering. In particular, students will be able to apply various methods to solve a range of problems from applied mathematics and engineering, including multivariable calculus, differential equations, Laplace transforms, matrix theory, and Fourier series.

Through regularly attending lectures and applying themselves in tutorial exercises, students will develop understanding of the concepts of engineering mathematics and competency in problem-solving techniques and creative and critical thinking.

Relation to graduate attributes

The lectures, problem classes and tutorials are designed to incorporate a promotion of the UNSW Graduate Attributes, with a particular focus on:

1. the skills involved in scholarly enquiry into mathematics and its applications;

2. an in-depth engagement with mathematical knowledge in its engineering context;

3. the capacity for critical and analytical thinking and for creative problem solving;

4. the ability to engage in independent and reflective learning;

5. the capacity for enterprise, initiative and creativity;

6. the skills of effective communication.

Teaching strategies underpinning the course

New ideas and skills are introduced and demonstrated in lectures. Problem classes show how to develop methodologies to solve exercises related to the lecture material. Students develop these skills further by applying them to specific tasks in tutorials and assessments.

Rationale for learning and teaching strategies

We believe that effective learning is best supported by a climate of enquiry, in which students are actively engaged in the learning process.
We believe that effective learning is achieved when students attend all classes, have prepared effectively for classes by reading through previous lecture notes and, in the case of tutorials, have made a serious attempt at a representative sample of the scheduled problems prior to the tutorials.
Furthermore, lectures should be viewed by the student as an opportunity to learn, rather than just copy down lecture notes.
Effective learning is achieved when students have a genuine interest in the subject and make a serious effort to master the basic material.
The art of logically setting out mathematics is best learned by watching an expert and paying particular attention to detail. The teaching methods used in this course attempt to make the solution steps to problems as clear and as logical as possible. Given that a solution step is a logical consequence of the inputs, it then does not have to be remembered as a special case, thus leading to a real understanding of the mathematical algorithm and reducing the need for learning by rote.
The Graduate attributes mentioned above will be encouraged, in part, by the lecturer or tutor following the criteria set out in the Course and Teaching Evaluation And Improvement (CATEI) Process with elements of:

1. communicating effectively with students (for example, by emphasizing main points; repetition of important ideas when appropriate; use of clear speech and writing; use of simple language; etc)

2. stimulating student interest in the subject matter (e.g., through the presentation and discussion of real-world examples and interesting relevant applications; displaying a natural enthusiasm for the subject material themselves; etc)

3. fostering students to think critically and learn independently (e.g., by posing interesting questions in classes [and not necessarily giving the answers!] that demand careful, exact evaluation and judgement)

4. providing helpful feedback to help students learn (e.g. by providing worked solutions to the Class Tests so that students may reflect on how to improve)

5. encouraging student input and participation during classes (e.g., through the use of friendly, interactive discussions; by raising open, relevant questions to the class; by encouraging students to raise questions during class)

6. being generally helpful to students and being well prepared.

Assessment

The assessment in this course has four components:

Task	Weight	When
Online quizzes	8%	One per week
Test 1	15%	Week 4
Test 2	15%	Week 7
Writing assignment	2%	Week 9
Final Exam	60%	May exam period

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above and the specific UNSW Graduate Attributes listed. Paramount will be the ability to solve problems related to the applied mathematics and engineering applications covered in the course.

Assessment criteria: The main criterion for marking all assessment tasks will be a demonstrated understanding of the concepts of engineering mathematics that are presented in lectures, as illustrated by problem-solving techniques. Marks will be awarded for correct working, logical and appropriate reasoning - and not just for a final answer.

UNSW assesses students under a standards-based assessment policy. For how this policy is applied in the School of Mathematics and Statistics, see

> `www.maths.unsw.edu.au/currentstudents/assessment-policies`

All assessment tasks must be YOUR OWN WORK, or severe penalties will be incurred.

Online quizzes

A weekly online (MapleTA) quiz will give students regular feedback on their progress through the course and encourage them to keep up-to-date with the material. The quiz for a given week will go live on Monday morning and must be completed by the Wednesday of the following week (check MapleTA for the exact deadlines). You will complete a short set of exercises and type your answers into MapleTA to be computer marked. The **best 8 out of the 10** quizzes will count towards **8%** of your final mark for the course.

Class Tests

The class tests will give students feedback on their progress and mastery of the material. They are designed to encourage reflective learning so that students may analyse their performance and be well prepared for the Examination. Each class test lasts **40 minutes** and counts 15% towards your final mark (so **30%** combined). You will use MapleTA, just like for the online quizzes, but under supervision in one of the **computer labs**.
Test 1 covers **topics 1–3** and takes place in **week 4**.
Test 2 covers **topics 4–6** and takes place in **week 7**.

Writing assignment

You will submit a short assignment in **week 9**, consisting simply of typed solutions to a few selected questions from the online quizzes. Details about submission will be given on Moodle. The assignment will be graded by your tutor and count for **2%** of your final mark.

Examination

Rationale: The final Examination will assess student mastery of the material covered in the lectures.
The examination will be a **2 hour paper**, and counts for **60%** of your final mark. Further details will be available in class closer to the time.

Additional resources and support

Tutorial Exercises

The problem set (with selected answers), available on Moodle, will be used in tutorials and the problem classes. These problems are for YOU to do to enhance mastery of the course. You will learn a lot more if you try to do the relevant problems prior to tutorials or problem classes.

Outline Lecture notes

These notes, available on Moodle, are intended to give a brief outline of the course to be used as an aid in learning. They are not intended to be a replacement for attendance at lectures or tutorials. In particular, they contain few examples. Since examinations in this course consist mainly of examples, you will seriously compromise your chances of passing by not attending lectures and tutorials where many examples will be worked out in detail.

Textbooks

- E. Kreyszig, *Advanced Engineering Mathematics* (Wiley, 8th or 9th Ed.)

- S.L. Salas & E. Hille, *Calculus: One and Several Variables* (Wiley, 7th, 8th, 9th or 10th Ed.)

You need not buy these books, however they are recommended as back-up resources to the lecture material. You may be able to find earlier editions at a cheaper second-hand price and they would suffice. Also, the library has an electronic copy of Kreyszig, and hard copies of Salas and Hille.

Moodle

All course materials will be available on Moodle. You should check regularly for new materials.

Mathematics Drop-in Centre

The Mathematics Drop-in Centre offers free help to MATH2019 students in achieving their learning and problem solving goals. This is a consultation centre where students can come for free help with certain first- and second-year mathematics subjects. The type of help offered by the tutors of the centre is either one-on-one assistance or, at busier times, assistance in small groups. No appointment is necessary. Students typically bring their partial solutions for questions to the centre. A centre tutor then provides guidance and advice. The Mathematics Drop-in Centre is located in **RC-3064**. The opening hours of the centre should become available on the centre website late in Week 1:

`www.maths.unsw.edu.au/currentstudents/Mathematics-Drop-in-Centre.`

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course each time it is run. We carefully consider the student responses and their implications for course development. It is common practice to discuss informally with students how the course and their mastery of it are progressing.

Administrative matters

Additional Assessment

The School of Mathematics and Statistics has a strict policy on additional assessment. It can be found at

www.maths.unsw.edu.au/currentstudents/additional-assessment

School Rules and Regulations

Students must read and understand the general rules regarding attendance, release of marks, special consideration etc. These are available via

www.maths.unsw.edu.au/currentstudents/help-students-undergraduate

Plagiarism and academic honesty

Plagiarism is the presentation of the thoughts or work of another as one's own. Issues you must be aware of regarding plagiarism and the university's policies on academic honesty and plagiarism can be found at

www.student.unsw.edu.au/plagiarism/

List of topics

The hours allocated for lectures on each topic allow for several problem classes during the lecture time slots.

1. Partial Differentiation (5 hours): definition and interpretation of a partial derivative; the chain rule; multivariable Taylor series; linear approximation; Leibniz's rule for differentiating integrals.

2. Extreme Values (3 hours): extrema for functions of two variables; constrained extrema and Lagrange multipliers.

3. Vector Field Theory (6 hours): brief revision of vector algebra; vector-valued functions of one variable; gradient of a scalar field and directional derivative; divergence and curl of a vector field; line integrals; fundamental theorem of line integrals.

4. Double Integrals (7 hours): definition and basic properties; volume under a surface; calculation of double integrals; area; reversing the order of integration; density, mass and centre of mass; moments of inertia; double integrals in polar coordinates.

5. Ordinary Differential Equations (6 hours): first order equations; separable equations; integrating factor for linear non-homogeneous equations; higher order equations; linear, homogeneous, constant coefficient problems; complex and double roots; free oscillations; non–homogeneous linear equations; method of undetermined coefficients; forced oscillations; variation of parameters.

6. Matrices (6 hours): brief revision, including special matrices; matrix multiplication; inverse of a matrix; eigenvalues and eigenvectors; orthogonal matrices and diagonalisation; systems of linear ODEs and applications.

7. Laplace Transforms (7 hours): introduction; transform of a derivative; shifting theorems and the step function; partial fractions; solving ODEs and systems of ODEs; using Laplace transforms.

8. Fourier Series (8 hours): periodic functions; trigonometric series; Fourier series; Euler formulae; functions of arbitrary period; even and odd functions; half–range expansions; forced oscillations.

9. Partial Differential Equations (6 hours): basic concepts; vibrating string; D'Alembert's solution; wave equation; heat equation.