MATH2011

SEVERAL VARIABLE
CALCULUS

Semester 1, 2015
MATH2011 – Course Outline

Information About the Course

Course Authority: Dr Mircea VOINEAGU

Lecturers:
Dr Mircea VOINEAGU (Weeks 1–6 inclusive), RC–6112, email m.voineagu@unsw.edu.au
Dr Shev MACNAMARA (Weeks 7–12 inclusive), RC–6107, email s.macnamara@unsw.edu.au

Consultation: The lecturers and/or your tutor will tell you their consultation times in class.

Credit, Prerequisites, Exclusions:
This course counts for 6 Units of Credit (6UOC).

**Prerequisite:** MATH1231 or MATH1241 or MATH1251.

**Excluded:** MATH2019, MATH2049, MATH2069, MATH2100, MATH2110, MATH2111, MATH2510.

There is a higher version of this subject, MATH2111. The entry requirement for the higher course is a mark of at least 70 in MATH1231 or MATH1241 or MATH1251. See the section on final marks on page 4 for details on the joint assessment of MATH2011 and MATH2111.

Lectures: There will be four lectures per week:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Theatre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>1pm</td>
<td>EE G24</td>
</tr>
<tr>
<td>Wednesday</td>
<td>5pm</td>
<td>EE G25</td>
</tr>
<tr>
<td>Thursday</td>
<td>4pm</td>
<td>Webster B</td>
</tr>
<tr>
<td>Friday</td>
<td>3pm</td>
<td>OMB 149</td>
</tr>
</tbody>
</table>

**NOTE:** These theatres are correct at time of printing, however they may change. Please check your online timetable for the most up–to–date information.**

Tutorials: There will be one tutorial per week starting in week 2.

Late tutorial enrolments and changes of tutorial time after the cut-off time are handled according to the procedure described here:

http://www.maths.unsw.edu.au/currentstudents/how-change-mathematics-tutorials

Also note that requests for changes of tutorial time will be accepted only for a demonstrated timetable clash or work commitment. Students may not choose a particular tutorial class.

The tutorials will be generally looking at problems relevant to material covered in the previous week’s lectures. Students are strongly advised to do all “key” questions marked K in the problem book before attempting any others.

Moodle: Further information, skeleton lecture notes, past tests and exams, and other material will be provided via Moodle


We will also use Moodle for announcements.
Course Aims

This course introduces the mathematics crucial to mechanics, dynamics, electromagnetism, fluid flow, financial modelling and many areas of pure and applied mathematics. The course combines and extends the ideas from one variable calculus and linear algebra to develop the calculus of functions in $\mathbb{R}^2$ and $\mathbb{R}^3$. The final topic is an introduction to Fourier series, which concerns the representation of functions of a single real variable by infinite trigonometric series. In this course, the connection between diagrams/visualization and symbols is particularly important. Understanding that relationship is one of the main aims of the course.

Relation to Other Mathematics Courses

Mathematics may be divided into the broad categories of analysis (calculus), algebra, geometry and logic.

This subject fits into the analysis and geometry categories and follows on from material you will have learned in first year calculus and algebra. It forms the first step into the area of differential geometry, an area vital to modern theoretical physics.

MATH2011 is fundamental for those majoring in any branch of Mathematics, Physical Science, Engineering or Finance.

Assessment

Assessment in this course will consist of the following:

| Test 1 | worth 15% | A 40 minute test held in Monday lecture of week 5 covering the material from sections 1 – 7.* |
| Test 2 | worth 15% | A 40 minute test held in the Friday lecture of week 10 covering material in sections 8 – 15.* |
| Exam | worth 70% | A 2 hour exam covering the entire course at the June examinations. |

* Note: The precise range of material covered by each test will be announced in lectures and tutorials before each test.

See the section on final marks on page 4 for further information.

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes outlined above, specifically, the ability to set up and accurately solve problems involving multiple real variables.

Assessment criteria: The main criteria for marking all assessment tasks will be clear and logical presentation of correct solutions.
Tests

Rationale: The tests held during session time are intended to provide feedback and designed to make sure that you have mastered the basic material. We will give you an idea of the style of these tests by releasing some past tests on Moodle. Any major changes will be communicated through lectures and/or Moodle announcements.

Note: we require clear and logical presentation of correct solutions as well as the appropriate use of diagrams.

You may bring your own non–programmable hand–held Scientific Calculator to the tests. Calculators will not be provided for you. Only calculators on the list of approved calculators may be used in the end of semester exams. This list is similar to the list of calculators approved for HSC examinations.

Well BEFORE the tests, calculators must be given a UNSW "sticker", obtainable from the School of Mathematics and Statistics Office, and other student centres. For details see

http://www.maths.unsw.edu.au/currentstudents/exam-information-and-timetables

If you are absent from the test, you must provide a medical certificate to your tutor. An M will be recorded and your final mark will be calculated by scaling up the other tasks. (Note that this does not mean that missing one test will double the mark for the other: we will scale the exam and test together.)

Examination

Duration: Two hours.

Rationale: The final examination will assess student mastery of all the material covered in the lectures, except for any material specifically identified as non-examinable (there may be no such material).

Weighting: 70% of your final mark.

Calculators: For end of semester UNSW exams students must supply their own calculator. Information on calculators is as above under 'Tests'.

Any further details about the final examination will be available either in lectures and through Moodle towards the end of session.

Final Mark

Your (preliminary) final mark out of 100 will be a scaled version of the raw mark formed by combining the tests and exam. Scaling into final grades will be performed in conjunction with the Higher course, MATH2111 to reflect the greater difficulty of that course. We will award few (if any) High Distinctions and few Distinctions in MATH2011: most of these higher grades will be given in MATH2111. Therefore students aiming at higher grades should enrol in MATH2111.
Additional Resources and Support

Tutorial Exercises

The Problem Book (Coursepack) will be posted on Moodle. These problems are for YOU to do to enhance mastery of the course. Some of the problems have numerical answers but we do not have a set of worked solutions. The tutorials will use the Problem Book.

The Tutorial Exercise Schedule is as follows:

<table>
<thead>
<tr>
<th>Week</th>
<th>Questions Selected From</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No tutorial but try 1–14 as revision</td>
</tr>
<tr>
<td>2</td>
<td>15–27</td>
</tr>
<tr>
<td>3</td>
<td>28–56</td>
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<tr>
<td>4</td>
<td>57–80</td>
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<tr>
<td>5</td>
<td>81–89</td>
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<td>6</td>
<td>90–96</td>
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<tr>
<td>7</td>
<td>97–111</td>
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<td>8</td>
<td>112–119</td>
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<td>9</td>
<td>120–136</td>
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<td>10</td>
<td>137–153</td>
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<td>11</td>
<td>154–171</td>
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<tr>
<td>12</td>
<td>172–182</td>
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<tr>
<td>13</td>
<td>183–192</td>
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</tbody>
</table>

Lecture notes

Lecture notes will be made available through Moodle. Normally we will provide, before each section begins, skeleton lecture notes. The lectures will be based on those and the lecturer will write further, e.g. solve problems. It is probably best to print the lectures notes (maybe 2 to a page) and bring them to lectures, where you can write on them the solutions to problems etc. (The notes have some colour but a black-and-white printout is fine.)

Textbooks

There is no compulsory text for MATH2011.

One book that incorporates virtually all of the course material of MATH2011 is

“Calculus of Vector Functions” (3rd Ed.) by Williamson et al, 1972.

(There are newer versions of this book, however, the content deviates from the above edition and so would be of limited value to students.) The UNSW library has 2 copies of the 3rd edition and when we checked BookFinder.com there were some second-hand copies available.
A useful reference book that will be familiar to you is the same Calculus text that is used in first-year MATH1131/1231:

“Calculus - One and Several Variables” by Salas, Hille and Etgen.

Please note that this book does not quite cover all of the course material from MATH2011, such as Fourier series.

There are many texts covering most of the material in this course, and you may find one of these just as suitable: check the library for books called something like “Calculus” or “University Calculus”. If you are looking for a text that treats the subject at a more mature and deeper level, then consult “Vector calculus” by Baxandall and Liebeck.

You will also find your first year algebra and calculus notes useful.

The actual content of the course will be defined by the lectures.

**Past Tests and Exams**

Some past class tests and exams will be released through Moodle. All past exams are in the library. If time permits then some of these will be discussed in lectures.

**Computing**

All students in mathematics courses are given a computing account in the School of Mathematics and Statistics and may use the PCs in the School of Mathematics Computing Laboratories in M020 and G012 in the centre wing, Red Centre.

You may already have an account and be able to use your password from last year. If not, you should use the School’s Student Web Portal to set your password.

There is **no** formal computing component in the MATH2011 course. There are no references to Maple or Matlab in the course problem booklet and no assessment will require Maple or Matlab.

However, we expect you to explore the use of Maple or Matlab in many of the types of problems in the course problem book and especially to help develop your three dimensional visualisation skills.

For basic help with Maple refer to the “First Year Computing Notes” (also available on the School’s Web Site) and/or use the online help. For Matlab use the online help.

**Computer Laboratories**

Please see

http://www.maths.unsw.edu.au/currentstudents/computing-information
Rough Course Schedule

The syllabus consists of 19 topics as shown in the table below. Lectures may fall slightly behind or get slightly ahead of this timetable. At the discretion of the lecturer, all or part of some lectures may be used as a Problem Class where no new material is introduced but worked examples are shown.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vectors</td>
</tr>
<tr>
<td>1</td>
<td>Curves</td>
</tr>
<tr>
<td>1-2</td>
<td>Surfaces</td>
</tr>
<tr>
<td>2</td>
<td>Partial Derivatives and Continuity</td>
</tr>
<tr>
<td>2</td>
<td>Chain Rule</td>
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<tr>
<td>2-3</td>
<td>Gradient and Directional Derivatives</td>
</tr>
<tr>
<td>3</td>
<td>Normal and Tangent Lines, Tangent Planes, Differentials</td>
</tr>
<tr>
<td>4</td>
<td>Taylor Series</td>
</tr>
<tr>
<td>4-5</td>
<td>Critical Points and Lagrange Multipliers</td>
</tr>
<tr>
<td>5</td>
<td>Jacobian Matrix and Inverse Functions</td>
</tr>
<tr>
<td>6</td>
<td>Double Integrals</td>
</tr>
<tr>
<td>6</td>
<td>Double Integrals in Polar Co-ordinates</td>
</tr>
<tr>
<td>7</td>
<td>Triple Integrals</td>
</tr>
<tr>
<td>7</td>
<td>Cylindrical and Spherical Co-ordinates</td>
</tr>
<tr>
<td>7-8</td>
<td>Applications of Triple Integrals</td>
</tr>
<tr>
<td>8</td>
<td>Change of Variables</td>
</tr>
<tr>
<td>8</td>
<td>Line Integrals and Green’s Theorem</td>
</tr>
<tr>
<td>8-9</td>
<td>Parameterisation of Surfaces, Surface Integrals</td>
</tr>
<tr>
<td>9</td>
<td>Divergence and Curl</td>
</tr>
<tr>
<td>10</td>
<td>Stokes’ Theorem</td>
</tr>
<tr>
<td>11</td>
<td>Divergence Theorem</td>
</tr>
<tr>
<td>12</td>
<td>Fourier Series</td>
</tr>
</tbody>
</table>

The topics will be covered in the given order. The course is rather packed with material so both lecturers and students will need to keep moving forward to cover the course.

Course Evaluation and Development

The School of Mathematics and Statistics evaluates each course every 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.

The current structure of the course assessment and timetable reflects comments made by students in previous years.
Administrative Matters

Additional Assessment

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

http://www.maths.unsw.edu.au/currentstudents/exam-information-and-timetables

Note the rule for second and third year courses providing automatic additional assessment to students with marks in the range 40 to 49. Special notification is not sent to those students and they need to look up the time and place of additional assessment.

School Rules and Regulations

Students must read and understand the School of Mathematics and Statistics Policies as contained in the ‘Information for all UG students Semester 1’ document. This can be found at

http://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

http://www.lc.unsw.edu.au/plagiarism

Student Learning Outcomes

After taking this course you should have developed an appreciation of the basic methods of several variable calculus and what problems arise when generalising from the one variable case. You should also be able to solve maximum/minimum problems in several variables, set up and calculate multiple integrals and find Fourier series — these ideas form the major aims of this course.

Through regularly attending lectures and applying yourself in tutorial exercises, you will develop competency in mathematical presentation, written and verbal skills. We also expect you to improve your facility with mathematical software such as Maple and matlab, particularly to help your three dimensional visualisation skills.

Relation to Graduate Attributes

The above outcomes are related to the development of the Science Faculty Graduate Attributes, in particular: 1. Research, inquiry and analytical thinking abilities, 4. Communication, 6. Information literacy. See

http://www.science.unsw.edu.au/our-faculty/science-graduate-attributes
Teaching Strategies Underpinning the Course

New ideas and skills are introduced and demonstrated in lectures, then students develop these skills 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. To ensure effective learning, students should participate in class as outlined below.

We believe that effective learning is achieved when students attend all classes, have prepared effectively for classes by reading through previous lecture notes, in the case of lectures, and, in the case of tutorials, by having made a serious attempt at doing for themselves the tutorial problems prior to the tutorials.

Furthermore, lectures should be viewed by the student as an opportunity to learn, rather than just copy down or skim over 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. This skill is also best learned by regularly attending classes.

Course Motto

"Draw the diagram."