MATH3511

TRANSFORMATIONS, GROUPS & GEOMETRY

Semester 2, 2015
MATH3511 – Course Outline

Information about the course

Course Authority & lecturer:
Dr John Steele, Red Centre 5103, email j.steele@unsw.edu.au

Consultation: My consultation hours will be announced in week 2, but you can either drop in at other times (if I’m free) or use email to arrange an appointment.

Credit, Prerequisites, Exclusions:
This course counts for 6 Units of Credit (6UOC).
The pre-requisites are 12uoc of level 2 maths. Linear algebra (MATH2501 or MATH2601) is the most useful pre-requisite course.

Lectures: There will be three lecturers per week:

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Location</th>
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<tbody>
<tr>
<td>Mon</td>
<td>1pm</td>
<td>OMB 144A</td>
</tr>
<tr>
<td>Wed</td>
<td>2pm</td>
<td>EE-225</td>
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<tr>
<td>Fri</td>
<td>3pm</td>
<td>OMB-144A</td>
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Tutorials: There will be one tutorial per week at 10am Fri in RC-1041.

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

Course Description

MATH3511 is a pass level third year pure mathematics course, suitable for students aiming at a wide range of mathematical careers, in teaching, graphics, data analysis and other areas of mathematics. It is also relevant to the analysis of patterns in art and biology.

Basic topics: Euclidean geometry, geometry of triangles, transformations, groups, symmetries, projective geometry.

The principal aim is to develop a working knowledge of some of the deeper aspects of Euclidean geometry, with an understanding of how groups of transformations cast light on the basic mathematical property of symmetry.

It builds on material in earlier years on geometry and linear algebra, combining these areas in understanding Euclidean and projective geometry and geometrical symmetry. Although it has applications in other areas, especially physics and computer graphics, its main aim is pure understanding of geometry and abstract algebra.

Maple is useful occasionally to calculate with examples but is not a principal part of
the course. You may also find the program geogebra useful for sketches, particularly
in the geometry section. Geogebra is freeware, and often used in High Schools.

Thus student learning outcomes are a sound appreciation and understanding of the
basic geometrical and algebraic properties, constructions and reasoning, with an
ability to calculate, prove and draw.

The course relates especially to the graduate attributes of 1. Research, inquiry and

Assessment

Assessment in this course rewards students for working consistently at the tutorial
problems throughout the session. It encourages the development of analytical
thinking, the ability to understand and solve problems, and to express mathematics
clearly in written form.

In tests and exams, marks will be awarded for correct working and appropriate
explanations and not just the final answer. Test and exam questions will largely be
based on tutorial problems.

The final mark in MATH3511 will be an aggregate mark based on:

- A 45 minute mid-session test in the tutorial of week 5, worth 20%. The content
  of the test will be announced by the end of week 4.
- Two assignments due in weeks 7 and 11, worth 15% each
- A 2 hour exam (on the whole course but weighted towards the last half), worth
  50%

Assignment solutions may be either handwritten or typed; diagrams may be drawn
with either hand or computer (e.g. Maple or geogebra). See below for academic
honesty policy related to assignments.

Late assignments are accepted but with a gradual decay of marks after the due date.
Any medical or similar problems affecting tests or assignments should be discussed
with the course authority as well as being reported according to UNSW procedures.

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

http://www.maths.unsw.edu.au/currentstudents/assessment-policies

The main criteria for marking all assessment tasks will be clear and logical presenta-
tion of correct solutions, in particular in the construction of proofs.
Absence from test:
If you are absent from the test, you must provide a medical certificate. In that case an M will be recorded and your final mark will be calculated from the other assessment tasks. If you are absent without a medical certificate you will receive an A which gives a mark of zero for that task.

Examination

Duration: Two hours.

Rationale: The final examination will assess student mastery of the material covered in the lectures.

Weighting: The final examination will count for 50% of your final mark.
Further details about the final examination will be available in class closer to the time.

Rough Course Outline:

1. Triangle geometry. Properties of triangles: median, incentre, excentre, orthocentre, inscribed circle, Euler line and the nine-point circle.

2. Circle Geometry. Inversion, poles and polars, inverting lines and circles


4. Projective Transformations. Projections, perspectives, the projective plane, conics.

5. Group theory. Permutations, generators and relations, subgroups, cosets, Lagranges theorem, factor groups, homomorphisms. Frieze and wallpaper groups, tilings.

Additional resources and support

Lecture notes
A set of outline lecture notes will appear on moodle.
Problem sheets

There will be a range of degrees of difficulty in the problems, from easy to hard, as well as filling in gaps in the lectures. Much of the exam and mid-session test will contain problems similar to those on the problem sheets.

Textbooks

There is no textbook, but useful books are:

R. Barnett, *Schaums Outline of Theory and Problems in Geometry*, UNSW library catalogue PQ516/73A
R.A. Johnson, *Advanced Euclidean Geometry* (Dover), UNSW P516.2/6
W.T. Fishback, *Projective and Euclidean Geometry* (Wiley) UNSW 516.57/18
E.A. Maxwell, *Geometry by Transformations*
G.E. Martin, *Transformation Geometry: An Introduction to Symmetry*
M.A. Armstrong, *Groups and Symmetry*

H. Weyl, *Symmetry*, is an inspiring small book that mixes an explanation of symmetry via groups with semipopular material on symmetry in e.g. Islamic art and biology. Let the lecturer know of any useful books you find.

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

Moodle

All course materials and important announcements will be available on moodle. You should check regularly for new materials.

Student Learning Outcomes

New ideas and concepts will be introduced in lectures and then applied to specific tasks in tutorials.

Through regularly attending lectures and applying themselves in tutorial exercises, students will reach the outcomes listed below.

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*
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 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 best learned by regularly attending classes.

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

Special Consideration

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/assessment-policies

If you are ill for a class test then you should present a medical certificate to your tutor and an M will be recorded. Do NOT use the on-line Special Consideration
Application for class tests.

If you are ill for the final exam then you should apply on-line for Special Consideration.

If your final mark is in the range 40-47 you are automatically eligible for a deferred exam, but your final mark, if you pass the exam, will be capped at 50. This capping will not apply if you were ill for the exam and have applied on-line in the usual way. If you are ill on the day of the exam, then you should not sit the exam, but should apply as above. If you are ill and your during the semester exam is less than 40 you are unlikely to be granted a deferred exam.

Academic Misconduct

The University of New South Wales has rules relating to Academic Misconduct. They can be found at http://www.maths.unsw.edu.au/currentstudents/assessment-policies

Rules for the Conduct of Examinations

The University of New South Wales has rules for the conduct of examinations. They can be found at http://www.maths.unsw.edu.au/currentstudents/assessment-policies

The Use of Calculators in the Examination

There are new rules regarding calculators in the final examination. The University is no longer supplying these. You should look at the web page
http://www.maths.unsw.edu.au/currentstudents/exam-information-and-timetables

School Rules and Regulations

Fuller details of the general rules regarding attendance, release of marks, special consideration etc are available via the School of Mathematics and Statistics Web page at
http://www.maths.unsw.edu.au/currentstudents/assessment-policies

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 and http://www.lc.unsw.edu.au/plagiarism/plagiarism_STUDENTBOOK.pdf.