FACULTY OF SCIENCE

SCHOOL OF MATHEMATICS AND STATISTICS

MATH3511

TRANSFORMATIONS, GROUPS & GEOMETRY

Session 2, 2017

MATH3511 – Course Outline

Information about the course

Course Authority: Dr J.D. Steele

Lecturers:

Dr John Steele RC-5103 email `j.steele@unsw.edu.au`.

Consultation: Consultation hours will be announced in class and on moodle.

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 hours of lecturers per week:

Wed 10am-12noon	Red Centre Theatre
Fri 12noon	Red Centre Theatre

Tutorials: There will be one tutorial per week at 2pm on Friday, starting in week 2. See myUNSW for location.

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, projective geometry, groups, symmetries.

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 to calculate with examples but is not a principal part of the course. You should also find the (freeware) program Geogebra useful for sketches, particularly in the geometry section.

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 analytical thinking abilities, 4. Communication and 6. Information literacy.

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.

An "assumed knowledge" test will be made available, probably on-line, for submission by the end of week 2 or 3. This test is intended to cover geometry from High School, and maybe some of the week 1 material. The mark for this test will not form part of the course final mark, it is intended to help you judge your basic geometric knowledge.

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 and/or be similar to previous tests or exams.

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

- A 45 minute mid-session test in *first lecture of week 5* on Sections 1 and 2 of the course, worth 20%
- Two assignments *due in weeks 6 and 11*, worth 15% each
- A 2 hour exam (on the whole course but weighted towards the last half), worth 50%

Assignment solutions should preferably be submitted electronically: see assignments for details. See below for academic honesty policy related to assignments.

Late assignments are not accepted without a special consideration application. If an extension is given, it will be final but no penalty is applied. 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 presentation of correct solutions, in particular in the construction of proofs.

Resit of class test:

If you miss the class test and provide valid documentation, you will be permitted to take a resit version of the test. This resit will be offered a week or two after the original test, at a time outside the usual class times, probably at either 8am or 6pm on a day to be agreed (and depending on availability of a room).

If you are absent without a medical certificate you will receive an A which gives a mark of zero for that task.

All students whose mark in the class test is below 60% (rounded up) will also be permitted to take the resit test — this includes students who miss the first test without valid documentation. Your mark at this test will be capped at whatever mark was the threshold to retake.

There will be no option to take the resit test at any other time than the one arranged.

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 Schedule:

1. Euclidean geometry (in 2D). Properties of triangles: median, incentre, excentre, orthocentre, inscribed circle, Euler line and the nine-point circle, cross ratio. Properties of circles: inversion, poles and polars, linkages.
2. Transformation geometry. Rigid transformations, rotations, translations, reflections, affine transformations, isometries, similarity, radial transformations.
3. Projective Geometry. Perspective transformations, projections, extended plane, projective plane, homogeneous coordiantes, conics.
4. Group theory. Permutations, generators and relations, subgroups, cosets, Lagrange's theorem, factor groups, homomorphisms, isomorphisms, small groups. Groups to classify frieze and wallpaper symmetries (if time).

Additional resources and support

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

Lecture notes

I will post outline lecture notes progressively through the semester.

Problem sheets

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

Software

Although it is not compulsory, I would expect you to use some form of geometric or algebraic software in this course, at least for the geometry sections.

Maple has a package devoted to 2-dimensional geometry, called `geometry`. You may have used some of its commands in earlier years: I will leave you to explore it.

The open source program geogebra will also be useful: it is available for windows, mac, linux and android systems, as well as an app for iPhones and as an on-line resource from a browser, see

`www.geogebra.org`

I understand geogebra is used in many High Schools, so some of you may have met it before. Again, I will leave you to explore its use. I will post a set of geogebra

exercises on moodle to help you become familar to the more useful tools. As the course progresses I will post geogebra files of some of the constructions.

If you are more familar with some other suitable software, feel free to use it.

You ought to all be capable of using ruler, compasses and protractors to draw suitable diagrams without a computer, of course.

Textbooks

There is no textbook, but useful books are:

R. Barnett, *Schaums Outline of Theory and Problems in Geometry*
R.A. Johnson, *Advanced Euclidean Geometry*
E.H. Askwith, *A Course of Pure Geometry*
W.T. Fishback, *Projective and Euclidean Geometry*
E.A. Maxwell, *Geometry by Transformations*
G.E. Martin, *Transfomation 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.

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`

All requests for special consideration should be submitted through the University's on-line system. This applies to **all** assessment tasks.

If your final mark is in the range 45-49 you are automatically eligible for a deferred exam, but your final mark 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 marks for in-semester tasks 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

Check 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 attendence, 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 integrity and plagiarism, as well as various guides and brochures can be found at
`http://www.lc.unsw.edu.au/academic-integrity-plagiarism`