UNSW SCIENCE

SCHOOL OF MATHS AND STATISTICS

MATH3701/MATH5700

HIGHER TOPOLOGY & DIFFERENTIAL GEOMETRY/MODERN GEOMETRY

Term 3, 2019

Cricos Provider Code: 00098G

MATH3701/5700 – Course Outline

Information about the course

Course Authority: A/Prof. Daniel Chan

Lecturer:
A/Prof. Daniel Chan RC-4104 email `danielc@unsw.edu.au`.

Consultation: Consultation hours will be posted on my webpage.

Credit, Prerequisites, Exclusions: This is a 6 unit of credit course with one lecture stream. Prerequisites: 12 units of credit of Level II Mathematics courses with an average mark of 70 or higher, including MATH2111 or MATH2011 (Credit) and MATH2601 or MATH2501 (Credit), or permission from Head of Department. It is advantageous to also have MATH3611 and, to a lesser extent MATH3711.

Exclusions: MATH3531.

Lectures: There will in general be 4 hours of lectures a week, Tuesday 2-4, Thursday 10-11 and Friday 1-2. Full lecture notes will be posted on my webpage and you might wish to glance over at least the definitions beforehand.

Tutorials: There will in general be one tutorial a week on Thursday 11-12 where you will be required to present material to the class.

e-learning: Further information, lecture notes, and other material will be provided on my webpage and my YouTube channel:

`web.maths.unsw.edu.au/~danielch`

`www.youtube.com/DanielChanMaths`

If you haven't learnt basic point set topology, you will need to do so from my YouTube playlist on point set topology, by week 4. Regardless, watching the playlist will be a good way to revise this material.

Course aims

This is one of the core pure mathematics higher third year courses. It introduces undergraduates to modern geometry in the form of differential geometry. The fascinating relationship with topology is also examined.

Relation to other mathematics courses

This course builds on the calculus methods developed in Several Variable Calculus (Math2011/2111). It covers material relevant to many branches of mathematics as

well as theoretical physics. It is essential for students who wish to further their studies in areas such as algebraic topology, Lie groups or algebraic geometry.

Student Learning Outcomes

In this course, you will learn about differential geometry through studying curves and surfaces in detail. You will also gain an appreciation of the modern intrinsic viewpoint of geometry through the theory of manifolds. In studying surfaces, topology naturally comes into play, and we will explore this fascinating connection via the Euler characteristic.

Both differential geometry and topology are deep and broad disciplines and it is impossible to cover all the basic topics in a one term course. I have chosen a syllabus which gives a coherent selection of topics, but nevertheless, one that is broad enough that if you succeed in mastering the material here, you should have no problems reading about other fundamental material in the literature.

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**.

Assessment

The final mark in MATH3701/5700 will be an aggregate mark based on:

- Class participation in tutorials worth 5% (see below)
- A 45 minute mid-session test, worth 20% in week 6 or 7.
- An assignment worth 15% tentatively due week 3.
- A 2 hour exam on the whole course, worth 60%

For tutorials in weeks 2-10, I ask that all of you get into teams of two, and prepare 5-10 minutes of material for the rest of the class. Ideally, this should be a solution to one of the problem set questions for that week, but it could also be clarification of material you found difficult in lectures e.g. filling in proofs left as exercises. You should post on Moodle, by Wednesday before the tutorial, your team and which question (or material) you will be presenting as ideally, you should pick different things if possible. At most two teams should work on any particular question, so

check Moodle before picking. My advice is to pick the question and post it on Moodle first. If you have difficulties answering it, come ask me for hints.

See below for academic honesty policy related to assignments.

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.

Tentative syllabus:

1. Extrinsic geometry of curves (1 week).
2. Extrinsic geometry of surfaces in space (3 weeks).
3. Manifolds (topological, smooth, Riemannian, complex). (2 weeks).
4. Topological classification of compact surfaces (3 weeks).

Additional resources and support

Important announcements will be on moodle and my website will include the lecture notes and problem sets. The lecture notes are complete in the sense that it includes all the material you need for the course.

Textbooks

There is no textbook for this course as I have chosen a path that is specifically designed for the UNSW pure mathematics curriculum. However, you may find the following books useful.

- James Munkres *Topology* (2nd Edition)
- Andrew Pressley *Elementary Differential Geometry*

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

Teaching strategies underpinning the course

Rationale for learning and teaching strategies

I will follow the lecture notes fairly closely during the lecture. Sometimes though, I will give a more visual treatment of the material and let you read mathematical details in the notes at your leisure. Working through and understanding the lecture material should be the main focus of your learning. This will require both critical analysis as well as problem solving.

As for all pure maths courses, there is a lot of material to cover in each lecture. I will post all lecture notes on my webpage and I suggest you have a copy on hand during the lectures. Some of you may find it advantageous to glance through them before the lectures, especially the definitions, since it takes a while to remember them. Others will prefer to look at them after the lectures. Experiment to discover what works for you.

I have structured the tutorial problems sets to reinforce and extend material in the lectures. You will need to prepare in teams, answers to one of the questions each week. I also suggest that you try to do at least half of each problem set each week. They are an excellent way to test if you are understanding the lecture material properly. The remaining questions can be used for test or exam revision.

As you progress to this advanced stage of your academic career, it is important that you be weaned from learning via tutorial questions only. When you learn, be it in industry or as a research academic, it will be rare that you will be given exercises. I thus encourage you to make up your own questions which will further your understanding of the material. You are welcome to present your musings during the tutorial, though you might want to check with me first.

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.

This course has been completely revamped, in a large part, as a response to student feedback and to cater to the UNSW3+ calendar.

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.

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`