UNSW SYDNEY

UNSW SCIENCE

SCHOOL OF MATHS AND STATISTICS

MATH5665
Algebraic Topology

Term 2, 2019

Cricos Provider Code: 00098G

Course Outline

Lecturer/Tutor: Dr. Mircea Voineagu

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Office: Red Centre (East Wing) Room 6112

Consultation Hours: TBA.

Most of the information you need to know about the course, including lecture notes can be gotten from the Moodle.

Lectures/Tutorials: There will be 3-4 hours of lectures every week except week 6.

Tutorials: There is one hour of tutorials every other week except week 6.

Relation to other mathematics courses

Ideal preparation for this course are MATH3611, MATH3711 and MATH3701. You need to know the basics about homotopy and fundamental group. You need to know abelian groups and isomorphism theorems well, and have good knowledge of point set topology.

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

About this course

Algebraic topology is about the study of topological spaces using algebraic invariants. In this course, we will mainly look at homology, which in some sense detects n-dimensional "holes" in a space and at higher homotopy groups which generalize the fundamental group. It will allow us to show that various spaces are non-homeomorphic (traditionally a hard thing) or non-homotopic.

Assessment

The grade for this course will be determined from 1 assignment (worth 25% each), a mid-test exam (worth 30%) and a final exam (worth 45%). It is expected that most of you will be getting close to full marks in the assignments. If you are having trouble with the assignments, you should talk to other students or to me about it. The most important thing is that you learn the material.

Assessment criteria: The main criteria for marking all assessment tasks will be clear and logical presentation of correct solutions, in particular in the construction

of proofs.

Studying for this course

This course will be taught in a similar vein to your third year core pure maths courses, but is more demanding as the proofs are now more involved. Some theorems require several lectures to prove and a considerable amount of machinery. The concepts will take a while to digest so don't expect to understand everything in lectures. Try to get as much as possible out of them, and go over the material regularly after class. I suspect that filling in these gaps in understanding will take up a significant amount of your study for this course. If you are understanding very little of the lectures, then that's probably an indication that you haven't properly understood material in earlier lectures. I also strongly suggest you supplement your learning by browsing the references below.

It may be a good idea to read the lecture notes before class, to help you absorb the lecture. There are few tutorials in this course, so you will be expected to do most of the exercises in your own time.

Student learning outcomes

Mathematically, I hope you will see how many of the ideas in MATH3711, MATH3701 and MATH3611 come together. In particular, you will apply the concept of groups and group homomorphisms, to study topological spaces. There will be more abstract concepts which may take time to digest, but hopefully you will appreciate how they allow us to precisely describe and understand topological phenomena we see everyday, such as "Why is there a point on a coconut where the hairs emanate from?".

From a skills perspective, I hope you will develop your problem solving and analytical skills. The course should also help you improve your conceptual thinking. You should understand by now, that modern mathematics is communicated in a very different fashion to other disciplines and to everyday speech. Though it can be terse, it has great precision. I hope in this course, you will gain a greater appreciation of the modes of mathematical communication.

Syllabus

- Homotopy, higher homotopy groups and covering spaces (1.5 weeks)
- Category and functors. Compactly generated spaces. (1 week)
- (Based) Cofibrations (1.5 week)
- (Based) Fibrations (1.5 week)
- C.W. complexes and cellular approximation theorem (.5)

- Homological Algebra: Chain complexes, long exact sequences. (1 week)
- Axiomatic and cellular homology theory (1.5 weeks)
- Computations and applications of cellular homology (.5 week)

References

The lectures will cover all the material that you need to know, but nevertheless, you will probably find it handy to supplement your studies by looking at texts such as those below.

- May, Peter A Concise Course in Algebraic Topology, Chicago Lectures in Mathematics.
- Munkres, James R. Elements of algebraic topology. Vol. 2. Reading: Addison-Wesley.
- Spanier, Edwin H. Algebraic topology. Vol. 55. No. 1. Springer Science & Business Media.
- Hatcher, Allen. Algebraic topology. 2002. Cambridge UP, Cambridge.

Continual Course Improvement

The School of Mathematics evaluates each course each time it is run. Feedback on the course is gathered using, among other means, UNSW's Course and Teaching Evaluation and Improvement Process. Student feedback is taken seriously, and continual improvements are made to the course based in part on such feedback.

This course has not been taught in the current format before. All feedback is welcome.

School of Mathematics and Statistics Student Policies

School of Mathematics and Statistics policy regarding tests, assignments additional assessment etc can be found at

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

The UNSW Plagiarism Policy is also there.