MATHS 255 Principles of Mathematics
Study Guide, Second Semester 2005

This is a one semester, 2 point paper, taught at the City Campus.

This paper aims to give a broad introduction to mathematical thinking and communication, rather than technique. The main thrust is not so much finding the right answer to a problem as convincing someone else (or yourself) that the answer must be right.

By the end of this paper, you will be familiar with the basics of how to go about proving something, you will be used to seeing a new definition and deriving simple consequences of that definition, and you will have met widely used mathematical objects like groups and equivalence relations. You will also have learnt more about some familiar structures: the natural numbers and the real numbers. All this will prepare you well for Stage 3 papers in Pure Mathematics. It should also prepare you to tackle new real-life problems instead of limiting yourself to problems someone else has already solved for you!

Because the nature of the course is quite different from what you have seen before, the teaching and assessment methods will also be new. An important part of what you are learning is the ability to *communicate* mathematics. Some time during lectures will be given over to group discussions, where you will be expected to decide and to convince your fellow students of how to prove the propositions on the blackboard. You will also be expected to participate in "Collaborative Tutorials": see below for details.

Syllabus.

Logic (1.5 weeks): Statements, variables, theorems, truth tables and other basic ideas of formal logic.
Set Theory (0.5 weeks): Sets, basic set operations, De Morgan's laws.
Induction (1 week): The axiom of induction and complete induction.
Relations and Orderings (1 week): Relations, (partial) orders, partitions and equivalence relations.
Functions (1 week): The formal definition of a function, composition, inverse.
Elementary Number Theory (1.5 week): The natural numbers and integers, divisibility, factorisation, the Euclidean algorithm, congruence mod n.
Algebra of polynomials (0.5 weeks): Division of polynomials, Euclidean algorithm for polynomials.
Groups (2 weeks): Binary operations. Groups defined. Examples. Subgroups, group homomorphisms, quotient groups and cosets.
Real Numbers (1 week): Axioms for the real numbers, total ordering, least upper bounds, Archimedian property, convergence of sequences.
Introduction to Real Analysis (2 weeks): Formal definitions of continuity and differentiability. Uniform continuity, Taylor's theorem.

Recommended Preparation. One of Maths 109, 130, 152 or 250, or a B+ or better in Maths 208, or equivalent.

Calculators. Calculators will be permitted in the Test and the Examination.

Course Material. The text is the Second Edition of *Chapter Zero Fundamental Notions of Abstract Mathematics* by C. Schumacher (Addison-Wesley). The course will follow this book closely, so we strongly recommend that you purchase your own copy. It will be available on short loan in the Science Library. Lecture notes for some topics not covered by the textbook will be handed out in lectures.

Assessment. This will be based on assignments and collaborative tutorials (20%), the semester test (10%) and the final exam (70%), OR on assignments and collaborative tutorials (10%), the semester test (10%) and the final exam (80%), whichever is higher.

Note that the test and coursework count at least 20% towards your final mark.

Work will be marked for its clarity and precision as well as its content. For example, a proof poorly expressed with symbols undefined might be failed even if the "idea" of the proof is correct. Conversely, if a proof is well set up it might gain a pass mark even if the method is completely wrong. We encourage students to work together on the assignments, but remember that what you hand in must be your own work!

The **Semester Test** will held during class time on Thursday September 22nd. No makeup test will be given.

The five **assignments** are to be handed in by 4pm on the following Thursdays: August 4th and 18th, September 15th and 29th, and October 13th.

The Student Resource Centre will not accept late assignments under any circumstances. Assignments placed in the wrong box will not be marked, so be careful where you put your work. The overall assignment mark will be based on these assignments and on marks in the collaborative tutorials (see below). Each assignment will be worth 80 marks and each collaborative tutorial will be worth 20 marks, to give a total out of 500 marks.

Lectures and Tutorials. The class will meet weekdays at 3pm, in Geology 1060 on Mondays, Tuesdays, Wednesdays and Fridays, and in Engineering 3407 on Thursdays.

Tutorial sessions will be held every Wednesday (except the first week of the semester). There will be six **'regular' tutorials** with an emphasis on review and working through problems and five **'collaborative' tutorials** where students work in groups of three on a problem to be handed in at the end of the session for marking.

The collaborative tutorials are run as follows: a tutorial assignment is completed during the tutorial working in groups of three (although we may accept groups 2 or 4 people if necessary). You don't have to be in the same group each time.

There will be a few short questions designed to be able to be answered in about 40-45 minutes. 10 minutes before the end you will be required to put your answers onto provided sheets which are handed in. A brief rundown of the answers is then given on an overhead.

Summary of Important Dates. R is a 'regular' tutorial, C is a 'collaborative' tutorial, A is an assignment due date. The **Semester Test** will held during class time on Thursday May 5. No makeup test will be given.

Week	Dates	Mon	Tues	Wed	Thurs	Fri
1	18–22 July					
2	25–29 July			R1		
3	1–5 August			C1	A1	
4	8–12 August			R2		
5	15–19 August			C2	A2	
6	22-26 August			R3		
		B	**R**	**E**	**A**	**K**
7	12–16 September			C3	A3	
8	19–23 September			R4	Test	
9	26–30 September			C4	A4	
10	3–7 October			R5		
11	10–14 October			C5	A5	
12	17-21 October			R6		

Office hours. You are encouraged to approach your lecturer with any questions or suggestions you have about the paper. I will try to keep the following office hours:

Monday: 2–3
Wednesday: 11–12
Thursday: 2–3

Lecturer.

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Paper Homepage. The homepage for this paper is

`http://www.math.auckland.ac.nz/~class255`

From here you will be able to download copies of the assignments and other handouts. Handouts will also be available on CECIL, and you will be able to check up on your coursework marks on there.

Language Support. This semester we plan to offer support for students in this course who have English as a second language. One of the main aims of this course is to develop skills in mathematical communication. Research in this department has shown that many students with weak academic English have difficulty achieving in Stage 3 courses, (especially in areas of proof and discussion), and we would like to start helping now. A weekly meeting time that suits as many students as possible will be arranged.