

UNDERGRADUATE PROGRAMS IN MATHEMATICS

Introduction

There have been many changes and exciting developments in mathematics over the last twenty to thirty years, and greater emphasis has been made on new areas of mathematics as well as on the application of mathematics to an ever widening range of pursuits in many different areas.

Much of the change has taken place as a result of the advent of the computer, the impact of which has been manifold. First of all, it has revitalized and extended many classical areas. For example, modern treatments of linear algebra extend on traditional approaches and give extra emphasis to its relevance to large scale computations that arise in imaging, weather forecasting, optimization and diverse areas of mathematical modelling, just to name a few. Secondly, the development of nonlinear dynamics and chaos has relied heavily on extensive computation that has forced an astonishing truth on the mathematical, scientific and engineering community – that determinism does not ensure regular or predictable behaviour. Finally, contemporary mathematical analysis is much more closely attuned to effective computational models arising in science, engineering and economics.

The Department of Mathematics is sensitive to the needs of the programs within the Division of Information and Communication Sciences, and participates actively in their design and delivery, with the aim of producing well rounded graduates educated with the mathematical skills that underpin the pursuit of their chosen professions. Within the wider Macquarie University community, the Department contributes to programs where there are opportunities to enhance the quantitative and modelling skills of our graduating students.

The Department of Mathematics is in the enviable position of being within the same Division as the Departments of Physics and Electronics, both vibrant units in their own rights. Such arrangements do not appear to be reflected in comparable universities in the Sydney area, and this presents us with a unique opportunity. The Department pursues opportunities to offer students in these areas units that integrate mathematics seamlessly into their programs of study.

Mathematics and its Applications

The traditional strengths of the Department of Mathematics at Macquarie University include groupings of mathematicians working in analysis, category theory and number theory. The recent appointments of colleagues working in the more applied aspects of the discipline present us with a unique opportunity to enter areas of mathematics not previously offered at Macquarie University, to embrace other areas of strength within the Division of Information and Communication Sciences in physics, electronics and computing, and to make the mathematics program more relevant to the needs of other sciences and technology as well as commerce. The new Program on Mathematics and its Applications offers students an enhanced portfolio of subjects in their degree programs, and enables the Department to better train them to work successfully in different aspects of science, technology and commerce.

The Department has expanded and enhanced its existing undergraduate program by including such topics as waves and nonlinear dynamics, important components in any proper treatment of applicable mathematics. The goal is a balanced program of pure and applied mathematics, with emphasis on flexibility and quality, encompassing both

theory and application, and covering the three major aspects of modern mathematics – analysis, modelling and computation. The extra topics introduced will also enhance the existing programs such as the Advanced Mathematics Program and the various joint degree programs with other disciplines in the University.

An important aspect of the new Program on Mathematics and its Applications is the multiple entry levels that are on offer. Depending on their background in high school mathematics, students are directed to one of three entry levels – elementary, mainstream and advanced. This ensures that the overwhelming majority of students will find entry level units that are both realistic and challenging. Very strong students have the opportunities to extend themselves, and the Numeracy Centre offers excellent help to those who need extra guidance.

- *Application and Enrolment Details*
 - Major: Mathematics
 - Coherent Study: Mathematics
 - Department: Department of Mathematics
 - Division: Division of ICS
 - UAC Preference: 300107 (BA) or 300517 (BSc)
- *General Requirements for BA*
 - Minimum number of credit points: 68
 - Minimum number of credit points at 200 level or above: 38
 - Minimum number of credit points at 300 level: 18
- *General Requirements for BSc*
 - Minimum number of credit points: 68
 - Minimum number of credit points at 200 level or above: 38
 - Minimum number of credit points in science at 200 level or above: 34
 - Minimum number of credit points in science at 300 level: 18
- *Specific Requirements at 100 Level*
 - Core either MATH135 – Mathematics IA
or MATH132 – Mathematics IA (Advanced)
 - Core either MATH136 – Mathematics IB
or MATH133 – Mathematics IB (Advanced)
- *Specific Requirements at 200 Level*
 - Core MATH235 – Mathematics IIA
 - Core one of MATH236 – Mathematics IIB
MATH232 – Mathematical Techniques
- *Specific Requirements at 300 Level – Option 1*
 - Core four of MATH300 – Geometry and Topology
MATH331 – Waves
MATH332 – Nonlinear Dynamics and Chaos
MATH334 – Mathematics III Advanced
MATH335 – Mathematical Methods
MATH336 – Differential Equations
MATH337 – Algebra IIIA
MATH338 – Algebra IIIB
MATH339 – Real and Functional Analysis

- *Specific Requirements at 300 Level – Option 2*
 - Core MATH335 – Mathematical Methods
 - Core MATH336 – Partial Differential Equations
 - Core one of MATH331 – Waves
 MATH332 – Nonlinear Dynamics and Chaos
 MATH337 – Algebra IIIA
 MATH339 – Real and Functional Analysis
 - Core one of PHYS301 – Electromagnetism and Quantum Physics
 PHYS306 – Optical Physics
 PHYS377 – Astrophysics I
 PHYS378 – General Relativity and Cosmology

Mathematics and Statistics

Mathematics and statistics have developed together for many years with probability theory as a central thread. In this program of joint major in the two disciplines, the aim is to train students to work in areas common to both mathematics and statistics, with a balance between theory and application, and to provide a solid grounding in the fundamentals of both. It will give a practical edge to those students who would otherwise only study mathematics, and it will give a theoretical edge to those students who would otherwise only study statistics. Each subject contributes to the development of the other, and any student who pursues both will come away better equipped to work in science, industry and commerce.

- *Application and Enrolment Details*
 - Major: Mathematics and Statistics
 - Coherent Study: Mathematics and Statistics
 - Department: Department of Mathematics, Department of Statistics
 - Division: Division of ICS, Division of EFS
 - UAC Preference: 300107 (BA) or 300517 (BSc)
- *General Requirements for BA*
 - Minimum number of credit points: 68
 - Minimum number of credit points at 200 level or above: 38
 - Minimum number of credit points at 300 level: 18
- *General Requirements for BSc*
 - Minimum number of credit points: 68
 - Minimum number of credit points at 200 level or above: 38
 - Minimum number of credit points in science at 200 level or above: 34
 - Minimum number of credit points in science at 300 level: 18
- *Specific Requirements at 100 Level*
 - Core either MATH135 – Mathematics IA
 or MATH132 – Mathematics IA (Advanced)
 - Core either MATH136 – Mathematics IB
 or MATH133 – Mathematics IB (Advanced)
 - Core either STAT170 – Introductory Statistics
 or STAT171 – Statistical Data Analysis

- Core either or COMP115 – Introduction to Computer Science
COMP155 – Introduction to Computer Science (Advanced)
 - Core either or COMP125 – Fundamentals of Computer Science
COMP165 – Fundamentals of Computer Science (Advanced)
- *Specific Requirements at 200 Level*

- Core MATH235 – Mathematics IIA
- Core two of MATH236 – Mathematics IIB
MATH237 – Mathematics IIC
MATH232 – Mathematical Techniques
- Core one of *STATISTICS MODULES* (3 units required)

MODULE 1

STAT272 – Probability
STAT271 – Statistics I
STAT278 – Computer Simulation

MODULE 2

STAT270 – Applied Statistics
STAT273 – Risk and Chance
one of STAT278 – Computer Simulation
STAT279 – Operations Research I

- *Specific Requirements at 300 Level*

- Core MATH335 – Mathematical Methods
- Core MATH336 – Partial Differential Equations
- Core MATH339 – Real and Functional Analysis
- Core STAT371 – Modern Statistical Concepts
- Core two of STAT302 – Data Mining and Graphics
STAT320 – Modelling and Quality Management
STAT321 – Logistics and Project Management
STAT328 – Market Research and Forecasting
STAT329 – Electronic Commerce: Database Applications
STAT373 – Design of Surveys and Experiments
STAT378 – Statistical Computing
STAT379 – Operations Research II
STAT395 – Biostatistics and Epidemiology

Advanced Mathematics

This is primarily designed for those students of higher mathematical ability, studying mathematics or some other subject which requires a considerable level of mathematical expertise. In particular, it is designed for students interested in mathematics or an area that uses a lot of mathematics such as astronomy, computing, electronics and physics, as well as banking and finance.

For more details, see the section “Advanced Program in Mathematics” in this booklet.

- *Application and Enrolment Details*
 - Major: Mathematics
 - Study Pattern: Mathematics – Advanced
 - Department: Department of Mathematics
 - Division: Division of ICS
 - UAC Preference: 300517 (BSc)
- *General Requirements for BSc*
 - Minimum number of credit points: 68
 - Minimum number of credit points at 200 level or above: 38
 - Minimum number of credit points in science at 200 level or above: 34
 - Minimum number of credit points in science at 300 level: 18
- *Specific Requirements at 100 Level*
 - Core either MATH135 – Mathematics IA
or MATH132 – Mathematics IA (Advanced)
 - Core either MATH136 – Mathematics IB
or MATH133 – Mathematics IB (Advanced)
 - Core two of COMP115 – Introduction to Computer Science
COMP155 – Introduction to Computer Science (Advanced)
COMP125 – Fundamentals of Computer Science
COMP165 – Fundamentals of Computer Science (Advanced)
ELEC166 – Introduction to Electronic Systems
PHIL134 – Introductory Formal Logic
PHYS140 – Physics IA
PHYS143 – Physics IB
STAT170 – Introductory Statistics
STAT171 – Statistical Data Analysis
- *Specific Requirements at 200 Level*
 - Core MATH235 – Mathematics IIA
 - Core MATH236 – Mathematics IIB
 - Core MATH237 – Mathematics IIC
 - Core MATH232 – Mathematical Techniques
 - Core one of MATH233 – Mathematics II Advanced
MATH239 – Geometry and Graphics
COMP238 – Numerical Computing
PHYS246 – Advanced Physics II
STAT272 – Probability
- *Specific Requirements at 300 Level*
 - Core MATH334 – Mathematics III Advanced
 - Core MATH335 – Mathematical Methods
 - Core four of MATH300 – Geometry and Topology
MATH331 – Waves
MATH332 – Nonlinear Dynamics and Chaos
MATH336 – Partial Differential Equations
MATH337 – Algebra IIIA
MATH338 – Algebra IIIB
MATH339 – Real and Functional Analysis

BRIEF DESCRIPTION OF UNDERGRADUATE MATHEMATICS UNITS

Educational Mathematics Unit at 100 Level

- MATH106 – A View of Mathematics

This is a general education unit of study, and is more about mathematics than of mathematics and is not a designated science unit. It is designed for students who, while perhaps having little mathematical knowledge, would like to be able to enjoy mathematics and who recognise its importance as part of our cultural heritage. The emphasis is on developing the ideas and the logical approach of the subject rather than on acquiring technical skills.

Elementary Mathematics Units at 100 Level

- MATH123 – Mathematics 123

This unit is an alternative to MATH130 for students with a standard secondary school background in mathematics who need additional mathematical skills for areas such as economics, finance, biology and chemistry. It omits certain topics in MATH130 which would be of little relevance to the subject areas mentioned above and instead develops the practical applications of the remaining topics.

Note that MATH123 is not a prerequisite for MATH135, a unit needed for further studies in mathematics and also for some computing and statistics units. Students who may need to study MATH135 should enrol in MATH130 instead of MATH123.

- MATH130 – Mathematics IE

This is the standard entry level unit in mathematics for those students who have not had the benefit of a detailed introduction to the calculus which is equivalent to a reasonably high level of the NSW HSC Mathematics course. This unit then serves as a prerequisite for further study in mathematics. Taken by itself, it provides the basic mathematical knowledge required by students in other disciplines.

Although there is no formal prerequisite, students should be familiar with certain topics included in the HSC Mathematics course. Students who have not studied mathematics for several years should consult the Learning Centre for Numeracy Skills regarding refresher courses.

Fundamental skills in algebra are developed at the outset and used to study basic topics in mathematics such as trigonometry, indices and logarithms, equations and inequalities, as well as progressions. The notion of differential and integral calculus is developed to a reasonable level, sufficient for many simple applications in other areas such as commerce, science and technology.

Mainstream Mathematics Units at 100 Level

- MATH135 – Mathematics IA

This is the first mainstream mathematics unit offered at Macquarie University. It is essential study for students in science and technology, and recommended for students in many other areas who wish to enhance their mathematical skills.

Apart from some brief discussion on complex numbers and congruences, the main topic in the algebra half of this unit concerns linearity and the interplay between algebra and geometry. Plane geometry is first used to motivate the study of systems of linear equations. Algebraic techniques involving matrices and determinants are then developed to study these problems further. The algebraic machinery developed is then used to study geometrical problems in 3-dimensional space.

The notion of a limit is developed to a more sophisticated level than in secondary school mathematics, and this is used to study the differential and integral calculus involving functions of one real variable to a far greater depth than before. Some simple numerical techniques on integration are also discussed.

- MATH136 – Mathematics IB

The notion of linearity first introduced in MATH135 is now developed through the introduction of the abstract notion of vector spaces. The new ideas are then used to study systems of linear equations further. Other topics in algebra include an introduction to group theory, one of the most fundamental concepts in modern mathematics.

The study of differential and integral calculus is taken further by the introduction of functions of two real variables and the study of first and second order ordinary differential equations. The notion of a limit is enhanced by the study of sequences and series. Ideas from power series are then used to study differential equations again.

Advanced Mathematics Units at 100 Level

- MATH132 – Mathematics IA (Advanced)
- MATH133 – Mathematics IB (Advanced)

These are the advanced versions of the standard units MATH135 and MATH136. Topics are covered in greater detail and rigour.

Mainstream Mathematics Units at 200 Level

- MATH232 – Mathematical Techniques

This unit develops techniques and skills that are fundamental in the study and application of mathematics at an advanced level. In any successful application, two contrasting but complementary skills must be developed: the ability to formulate a given “real world” problem in appropriate mathematical terms, and sufficient knowledge to obtain useful information and testable predictions from that model, by analytical and numerical means.

The unit shows how differential equations arise as mathematical models of such real phenomena in science, engineering and the social sciences, and introduces some tools – Fourier series and numerical methods – for the study and eventual solution of these equations. Fourier series and transforms are particularly useful in those situations where the system response (and indeed many functions) can be seen as a complex sum of simpler vibrations or oscillations. When analytical methods fail, or provide only limited information about the model, numerical techniques are essential to quantify its behaviour precisely: some simple methods are introduced and the conditions under which reliable and accurate solutions may be obtained are described.

- MATH235 – Mathematics IIA

The idea of a vector space first introduced in MATH136 and MATH133 is now enriched by the introduction of an inner product. This leads to the important notion of orthogonality which underpins many areas of mathematics. The idea of linear transformations which transfer linearity from one space to another is also discussed. The results and techniques are then applied to problems such as approximation, quadratic forms and Fourier series.

Differential and integral calculus involving functions of several real variables are discussed in greater depth than in MATH136 and MATH133. The ideas here are central to the development of mathematics in many different directions.

- MATH236 – Mathematics IIB

This unit deals with two of the most fundamental concepts in analysis – complex analysis and vector analysis.

Complex analysis is the study of complex valued functions of complex variables. Two approaches to the study of complex valued functions of one complex variable are discussed in this unit. The first of these, usually attributed to Riemann, is based on differentiation and involves pairs of partial differential equations called the Cauchy-Riemann equations. The second approach, usually attributed to Cauchy, is based on integration and depends on a fundamental theorem known nowadays as Cauchy's integral theorem.

The concept of vector analysis provides the tools for modelling physical phenomena such as fluid flow, electromagnetic and other field based theories. In this unit, we consider vector fields and integrals over paths and surfaces, and develop an understanding of the famous integration theorems of Green, Stokes and Gauss. These theorems transform physical laws expressed in differential form to integral form.

- MATH237 – Mathematics IIC

For many centuries, mathematics has drawn the greater part of its inspiration from physics. Over the past fifty years, computing has generated many interesting problems which have stimulated new areas of mathematical research. As a result, the emphasis in mathematics has shifted somewhat from the continuous towards the discrete. The purpose of this unit is to give a grounding in discrete mathematics. It is important preparation for both theoretical computing and abstract algebra.

In the computational half of this unit, the unifying theme is the concept of a language as a system of character strings obeying certain rules. Although one tends to think of computers as devices for performing calculations, it is better to think of them as machines for manipulating strings of symbols. We shall study languages in general, as well as the connection between languages and machines that manipulate them. Finite state machines and finite state automata are important mathematical models of the computing process. They are used to answer a number of theoretical questions such as giving a finite description of a language that contains infinitely many strings.

In the mathematical half of this unit, the study of algorithms is the unifying thread. We shall study mathematical techniques such as inclusion-exclusion, generating functions and recurrence relations. Graphs, trees and networks are fundamental data structures for computing, and form a natural way for representing problems of transportation, scheduling and communication.

- MATH239 – Geometry and Graphics

This unit focuses on the mathematical aspects of computer graphics and examines geometric topics to illustrate the interaction between mathematics and computing. Topics covered will include the description and manipulation of curves and surfaces, processing and coding images and data, and generation of realistic 3-dimensional pictures and imaginary fractal landscapes. Illustrations will be chosen from classical geometry and the futuristic world of fractals and chaos.

Advanced Mathematics Unit at 200 Level

- MATH233 – Mathematics II Advanced

This unit is primarily designed for students majoring in mathematics and enrolled in the BSc (Advanced Program). Topics will be chosen to excite and challenge talented students.

Mainstream Mathematics Units at 300 Level

- MATH300 – Geometry and Topology

Designed to widen geometric intuition and horizons by the study of topics such as projective geometry, topology of surfaces, graph theory, map colouring, ruler-and-compass constructions, knot theory and isoperimetric problems, this unit is especially recommended for those students preparing to become teachers of high school mathematics.

- MATH331 – Waves

Waves are ubiquitous. Our senses of sight and hearing depend very heavily on the interpretation of light and sound waves respectively. Also, water waves, elastic waves, seismic waves and other less obvious varieties of waves are important to us in natural and technological senses. The last century witnessed the advent of many new wave-based technologies, such as telecommunication, radars (including remote sensing and imaging radars) and lasers that utilise electromagnetic waves, whilst in the acoustic domain, ultrasonic imaging finds application in non-destructive testing and medicine. Further development and exploitation depends crucially on mathematical modelling and analysis. Such models allow us to interpret the intrinsic information contained in waves that are otherwise invisible (or inaudible), and infer the presence (or absence) of certain types of scattering features in the environment.

This unit introduces the theory of waves by a systematic study of the underlying partial differential equations. Waves involve the transfer, without bulk motion, of both energy and information. Fundamental properties of waves are first examined in the simplest 1-dimensional setting. The treatment is then broadened to 2- and 3-dimensional waves, particularly for acoustic and electromagnetic waves. Resonators and waveguides provide some examples of how waves behave in confined regions. In contrast, the scattering and diffraction of waves by obstacles in free space carries information about the scatterer itself; this is the basis of many imaging technologies.

- MATH332 – Nonlinear Dynamics and Chaos

The remarkable fact that determinism does not guarantee regular or predictable behaviour is having a major impact on many fields of science and engineering as well as mathematics. The discovery of chaos, or of chaotic motions, in simple dynamical systems changes our understanding of the foundations of physics and has many practical applications as well, shedding new light on the workings of lasers, fluids, mechanical structures and chemical reactions.

Dynamical systems involve the study of maps and systems of differential equations. The presence of a nonlinear element usually introduces totally novel phenomena that are absent in linear systems, even at low order. In this unit, the diversity of nonlinear phenomena is explored through the study of second order differential equations, and 1- and 2-dimensional maps. In unforced systems, examples of stable motions include limit cycles and periodic solutions. In harmonically forced systems, we study jump phenomena (where the system jumps discontinuously between two stable states as the frequency is slowly varied), as well as sub- and super-harmonic generation. A parameter-dependent system may radically change behaviour as that parameter is varied, and exhibit bifurcation: manifestations in maps and systems of differential equations will be studied. Chaotic motions will be introduced by a study of the driven pendulum, a second order system that includes nonlinear aspects usually ignored in simpler treatments. An appropriate balance between forcing and damping leads to irregular, but bounded, motions that do not repeat themselves, even approximately – truly chaotic motion in a simple deterministic system.

- MATH335 – Mathematical Methods

This central unit develops the ideas and techniques of analysis important in many branches of pure and applied mathematics. Topics include the theory of ordinary differential equations, including linear and nonlinear systems and their stability. Some special functions are also discussed, together with important applications in various branches of mathematics.

- MATH336 – Partial Differential Equations

Partial differential equations form one of the most fundamental links between pure and applied mathematics. Many problems that arise naturally from physics and other sciences can be described by partial differential equations. Their study gives rise to the development of many mathematical techniques, and their solutions enrich both mathematics and their areas of origin.

This unit explores how partial differential equations arise as models of real physical phenomena, and develops various techniques for solving them and characterizing their solutions. Especial attention is paid to three partial differential equations that have been central in the development of mathematics and the sciences – Laplace’s equation, the wave equation and the diffusion equation.

- MATH337 – Algebra IIIA

This unit develops the basic ideas of modern abstract algebra by concentrating on the many facets of group theory. As well as the standard material leading to the isomorphism theorems, we cover combinational aspects such as presentations of groups, the Todd-Coxeter algorithm, and subgroups of free groups via groupoids. Also studied are permutation groups, finitely generated abelian groups, soluble groups and group representations. This unit is especially suitable for students majoring in the theoretical aspects of physics or computing science.

- MATH338 – Algebra IIIB

This unit further develops the theory of algebraic structures which is first studied in MATH337, and involves the study of a selection of topics in ring theory and field theory.

The ring theory strand will develop the basic theory, including integral domains, ideals, quotient rings, principal ideal domains, unique factorization domains and Euclidean domains, followed by a study of one or two topics related to ring theory such as ideals in quadratic fields, the first case of Fermat’s last theorem, Hopf algebras or the Wedderburn structure theorem.

The field theory strand will also develop the basic theory, including the notion of irreducibility, simple, algebraic and transcendental extensions, and the tower law. The ideas of group theory studied in MATH337 will then be applied to the study of field extensions via the notion of automorphisms, culminating in the study of the Galois correspondence theorem.

- MATH339 – Real and Functional Analysis

This unit is concerned with a review of the limiting processes of real analysis and an introduction to functional analysis. Through the discussion of such abstract notions as metric spaces, normed vector spaces and inner product spaces, we can appreciate an elegant and powerful combination of ideas from analysis and linear algebra.

Advanced Mathematics Unit at 300 Level

- MATH334 – Mathematics III Advanced

This unit is designed for students enrolled in the BSc (Advanced Program). While only a few topics are treated, they are discussed in sufficient depth to appropriately convey the beauty and the spirit of modern mathematics.

ADVANCED PROGRAM IN MATHEMATICS

Introduction

In 1992, Macquarie University introduced an advanced BSc program, focussing on mathematics and related areas. It was primarily designed for those students of higher mathematical ability, studying mathematics or some other subject which requires a considerable level of mathematical expertise. In particular, it is designed for students interested in mathematics or an area that uses a lot of mathematics such as astronomy, computing, electronics and physics, as well as banking and finance.

Entry Requirements

For entry to this program, you will need a UAI of at least 95 or equivalent. It will be desirable to have Mathematics Extension 2.

Frequently Asked Questions

- Will I be doing only mathematics?
 - Not at all. Every Australian university, in its BSc program, requires you to get a good grounding in several sciences in the first year, and Macquarie University is no exception. In later years, you can concentrate heavily on mathematics, or you can balance it with complementary units from one or more of the other sciences.
 - The flexibility of the Macquarie University degree structure allows you to build your degree in a way that is most advantageous to your own interests and aspirations. Along with mathematics, you might study astronomy, computing, electronics, physics, chemistry or statistics, to name just a few.
- Can I study some non-science subjects?
 - Of course the majority of your BSc does have to be in science subjects. But up to about a quarter of your BSc program can be in non-science areas. And for this, you can choose from many subjects offered by the University.
- What degree do I get by doing the Advanced Program in Mathematics?
 - If you follow the program the whole way, you will graduate after four years with a BSc (Hons) degree and you will be ready to take off with a career in industry, or to study for a PhD and embark on a research career. Moreover, if you achieve First Class Honours, you not only will have a degree that is quite distinctive but you will also have a good chance of obtaining a postgraduate scholarship to support you while you undertake further studies.
- What are the extra opportunities in the Advanced Program in Mathematics?
 - In the Department of Mathematics, there are special advanced units that are usually available only to students in this program.
 - In general, students in this program take the same mathematics units as other students. These provide a solid grounding in ideas and techniques that pervade the whole subject. But as the content of these core units is to a large extent dictated by the need to service other sciences, they are not able to explore the more modern and exciting developments of the subject. For this reason there are several additional units for the students in the Advanced Program in Mathematics.

- Although these advanced units are more demanding than the ordinary ones, this is reflected in the very high proportion of High Distinction and Distinction grades awarded, so your grade point average need not suffer.
- For some other units you are permitted to enrol a year earlier than usual. This frees up your timetable in later years and gives you more opportunity to do the things that you want.
- In the long vacation at the end of each year, we offer a number of Vacation Scholarships to students in this program, for four to six weeks at \$250 per week, tax free. Under this scheme, each student undertakes a small piece of research under the supervision of one of the staff members. This provides the student with the opportunity of experiencing the world of research and also helps the staff to get to know the student better.
- I got a UAI of over 99. Would I not be wasting it by enrolling in the Advanced Program in Mathematics?
 - There is a strange notion held by many students that one should opt for the course with the highest UAI that one can get into, otherwise “one is wasting it”. This has led many students to make very unsuitable choices. Once you get above a UAI of 90, the cut-offs merely represent the equilibrium point of supply and demand and have nothing to do with the intrinsic difficulty of the course. Also, UAIs can also be a bit misleading. While it is true that a good UAI is an indicator for success there are many other factors. We have had many students in the program with very high UAIs who have done very well. But we have noticed that a couple of students with very high “force-fed” UAIs have had difficulty in coming to terms with the self-motivation required for university study. Others with good, but less spectacular, UAIs have really blossomed in the tertiary environment.
- How does the Advanced Program in Mathematics compare with advanced science programs at other universities?
 - You should check what other universities can offer and compare it with what the Advanced Program in Mathematics can offer you. There is no such thing as one being better than another overall. But one can be better for you, and only you can make that decision.
 - What distinguishes our Advanced Program in Mathematics is the central role it gives to mathematics. So if you intend to major in mathematics, you should consider the benefit of a program which is specially focussed on your needs.
- I am not doing Mathematics Extension 2. Is that a problem?
 - Entry to the Advanced Program in Mathematics is based solely on the UAI. But it is assumed that you will have done Mathematics Extension 2 at the HSC, or its equivalent. If you only have Mathematics Extension 1 but have the required UAI, you will still be accepted. What it would mean is that in first year, you may not be able to take advantage of the extra opportunities. But from the second year on, you will be treated exactly the same as all other students in the program.
- If I do not get in now, can I get in later?
 - If you miss out on the Advanced Program in Mathematics but get accepted for the normal BSc program (UAC code 300517) and do really well in your first year mathematics, you will be invited into the Advanced Program in Mathematics in the second year. We shall also consider suitably well qualified students transferring from other universities.

- Can I do an advanced BSc LLB or an advanced BSc (DipEd)?
 - Because of the small number of students wanting it, there is no specific UAC code for these combinations. You should apply for the BSc LLB or BSc (DipEd) or whatever, using the normal UAC code. If you gain the required UAI for the Advanced Program in Mathematics, then you can be included in the program, even though you remain enrolled in the other degree.

- What about actuarial studies?
 - Like the Advanced Program in Mathematics, the Actuarial Studies Program at Macquarie University is highly regarded. However, if you are trying to decide between them, make sure that you know what each of them involves. Talk to each department and make up your own mind.
 - Actuarial studies is very suitable for students who are good at mathematics but whose interests lie more in the world of commerce and who want a clearly defined career path. It is a very specialised course and normally only includes two mathematics units.
 - The Advanced Program in Mathematics is more suitable for students who have a fundamental interest in mathematics itself, who are interested in the diversity of applications and who do not want to limit their career prospects to just one industry.
 - Overall the employment prospects for a mathematician are as good as for an actuary but the areas of employment are more diverse. The actuary generally earns more but the mathematician has more flexibility in employment. Basically it all comes down to what sort of person you are.
 - Each year a few very good students in the final year of their Actuarial Studies Program begin, concurrently, a BSc degree within the Advanced Program in Mathematics.

- But is mathematics not like a dead language?
 - Mathematics may not be the oldest profession, but it is the most ancient of academic pursuits. All of the mathematics that is taught in schools today was around over 300 years ago. Even studying at university may only get you up to the beginning of the twentieth century. No wonder the subject has the reputation for being dusty, dry and dead.
 - What the general public does not realize is that important new discoveries are being made in mathematics at an ever increasing rate. In fact several problems that remained unsolved for over a hundred years have recently been solved. And whole new branches of mathematics are just opening up. These are exciting times for mathematics.

- Have computers not made mathematicians redundant?
 - Far from making mathematicians redundant, the advent of the computer has given mathematicians powerful new tools. More importantly, it has spawned whole new areas of mathematics by raising many fundamental questions that mathematicians are ideally equipped to answer. And important new advances in computing science have been built on new areas of mathematics. Mathematics and computing are not in competition. They are in an exciting partnership.

- Is Macquarie University strong in mathematical research?
 - Students are often reminded that they should choose a university not because of its research (which they may never get to see), but on the quality of its teaching. This is excellent advice. However, because of its small size, the Advanced Program in Mathematics group at Macquarie University will come more into contact with research activities than is likely at the other universities.
 - Macquarie University makes no apology for the quality of its scientific research. In terms of research grants awarded and international reputation, Macquarie University is now, for its size, one of the leading universities in the country in many, many subject areas. And one of these is mathematics.
 - The Department of Mathematics at Macquarie University has a number of staff members with distinguished international reputations. They are supported by other academic staff members who are very active in research. We have excellent groups in analysis, category theory and number theory, as well as a new direction in applied mathematics.
 - But you should ignore all this! What is most important to you now is the quality of our undergraduate teaching! And that, as we are constantly reminded by ex-students and independent surveys, continues to be first class.

HONOURS PROGRAM IN MATHEMATICS

Overview

The Department of Mathematics offers both full-time and part-time Honours Programs leading to the degrees of BA (Hons) or BSc (Hons) in mathematics. They are designed to provide training to undergraduates in the major areas of modern mathematics, and to enable them to study topics in more depth than is possible in an ordinary degree course. The emphasis is on providing a firm basis for possible further study either at the postgraduate level or independently. We also seek to produce a well rounded graduate in mathematics who can communicate intelligently with other mathematicians on many topics in modern mathematics.

There is evidence that an honours degree enhances career prospects for graduates in many areas of business and industry.

An honours degree makes easier the possible study for a higher degree at a later date. A good honours degree in mathematics is the basic requirement for admission to a postgraduate research program in mathematics and related subjects. The Honours Program in Mathematics will allow a student to assess the prospects for proceeding to such a research program.

Entry Requirements

- Satisfactory completion of at least four of the 300 level units in mathematics at Macquarie University listed below, or their equivalents from elsewhere:
 - MATH300 – Geometry and Topology
 - MATH331 – Waves
 - MATH332 – Nonlinear Dynamics and Chaos
 - MATH334 – Mathematics III Advanced
 - MATH335 – Mathematical Methods
 - MATH336 – Partial Differential Equations
 - MATH337 – Algebra IIIA
 - MATH338 – Algebra IIIB
 - MATH339 – Real and Functional Analysis
- A grade point average of at least 2.5 in 300 level units in mathematics.
- An overall grade point average of at least 2.5.

Program Details

The coursework requirements are that each student takes six semester units, and write an honours essay which will contribute the equivalent of 30% towards the final grade of honours. The essay topic will be chosen in consultation with a member of the staff member who has agreed to supervise the student. The choice of topic is usually confirmed early in the first semester and the student will have consulted members of staff before settling on a final choice of topic. The deadline for submission of essays is normally towards the end of October. The student will give an oral presentation of the essay. This presentation is assessed and will contribute the equivalent of 5% towards the final grade of honours.

The full-time Honours Program takes one year and the part-time Honours Program takes two years. For the full-time program, the student will take three coursework units in each half year and work on the honours essay at the same time. For the part-time program, the student will take two units in each of the first three semesters and devote the final semester to the honours essay.

The Honours Program usually commences in February, but it may be possible for some programs to commence mid-year.

Coursework Units

Currently, four coursework units, two per semester, comprise a core of the Honours Program. These are

- Analysis;
- Algebra;
- Topology; and
- Number Theory.

In both semesters a third unit is offered. These units may vary from year to year and often contain topics which are applications of the core units. Some typical recent examples are

- Distributions and Partial Differential Equations;
- Lie Groups;
- Mathematics of Quantum Mechanics;
- Fourier Theory;
- Mathematical Control Theory;
- Differential Equations in Banach Spaces; and
- Applied Functional Analysis.

Alumni

Here are some of our honours students in the last ten years, together with details of their supervisors and the titles of their essays.

- Dilshara Abayasekara
Supervisor: Ross Street
Essay: Species of structures
- Gabriel Abramowitz
Supervisor: John Corbett
Essay: Connections and general relativity
- Jarrod Bayl
Supervisor: Rod Yager
Essay: Elliptic curves of high rank
- Edwin El-Mahassni
Supervisor: Igor Shparlinski
Essay: The NTRU cryptosystem
- Alana Flentje
Supervisor: John Corbett
Essay: Mathematical logic: classical v quantum v intuitionistic

- Frances Griffin
Supervisor: Peter Pleasants
Essay: Symmetry and inflation properties of Penrose tilings
- Samantha Higgins
Supervisor: Bon Clarke
Essay: An introduction to non-cooperative game theory
- Stephen Keith
Supervisor: Xuan Duong
Essay: The holomorphic functional calculi of unbounded operators with polynomially bounded resolvent
- Oldrich Klima
Supervisor: Xuan Duong
Essay: The Calderon-Zygmund theory of singular integrals
- David Maher
Supervisor: Xuan Duong
Essay: Harmonic analysis: From Fourier series to wavelets
- Ben Odgers
Supervisor: William Chen
Essay: The distribution of prime numbers and the Riemann zeta function
- Daniel O'Neill
Supervisor: Bon Clarke
Essay: Estimation and control of linear stochastic systems
- Oded Rotem
Supervisor: Alf van der Poorten
Essay: Quadratic forms and quadratic fields
- Nicole Sharp
Supervisor: Alf van der Poorten
Essay: Elementary integrals and differential Galois theory
- Mark Weber
Supervisor: Ross Street
Essay: A mathematical analogy - Grothendieck topos theory
- Mark White
Supervisor: Bon Clarke
Essay: Pohozaev's identity and uniqueness for elliptic equations and systems
- Amy Young
Supervisor: Ross Street
Essay: Trace monoidal categories

RESEARCH AND POSTGRADUATE STUDIES

Overview

The Department of Mathematics offers postgraduate research programs, both full time and part time, leading to the degrees of MSc or PhD in mathematics.

Mathematics provides a unique training in abstract reasoning and problem solving. Research in mathematics at Macquarie University is well respected both nationally and internationally, with groupings of mathematicians working in analysis, category theory and number theory, as well as a new direction of research in waves and non-linear dynamics. There are several researchers of very high academic profile, and the Department attracts a substantial amount of external research funding and a steady stream of international visitors who collaborate with members of the Department, making it an ideal environment for postgraduate and postdoctoral research.

The strengths of the Department of Mathematics have been organised into a number of groups which interact formally and informally with other Australian and international mathematicians.

Research Groups and Areas

- Analysis

The research interests of the Analysis Group span functional analysis, harmonic analysis, Lie groups, symmetric spaces, partial differential equations and control theory. Some of the problems studied are mathematical formulations of physical situations and the solutions provided have applications to real world problems. For example, wavelet analysis is recognized as a significant advance in signal processing and compression. Similarly, answers to control theoretic questions at the quantum level are essential to realize the potential of the coming generation of computing devices. Members of the Analysis Group enjoy extensive research interaction and collaboration, nationally and internationally, and attract many overseas visitors to Macquarie University. They also receive many invitations to be speakers and main speakers at national and international conferences and workshops.

- Category Theory

The Australian Category Seminar meets weekly, every second Wednesday of every month at the University of Sydney, and other Wednesdays at Macquarie University. The seminar includes staff and students from Macquarie University, the University of Sydney, the University of Western Sydney and the University of Technology, Sydney, as well as frequent visitors.

The Centre of Australian Category Theory (CoACT) was formed to provide the environment for the top international centre for higher-dimensional category theory and a major international centre for general category theory. It continues to pursue vigorously research into those parts of mathematics and computer science which find natural expression and advancement in terms of category theory and to train research students of the highest quality. It pursues the development of algebra of widespread applicability for the synthesis and analysis of systems and processes in fields as diverse as physics and computer science, and also mathematics itself. Although having operated as a coherent group since the founding of the ongoing Australian Category Seminar in 1971, CoACT was formally established in 1999.

The Scott Johnson Memorial Scholarship is available for full-time PhD studies at the Centre of Australian Category Theory at Macquarie University. Applicants should hold a First Class Honours degree in an appropriate field and be eligible for admission to the degree of Doctor of Philosophy in the Division of Information and Communication Sciences in the area of Mathematics. Entry details and application forms are available from the Higher Degree Research Unit.

- Number Theory

The Number Theory Group has interests in many of the areas of modern number theory, including uniform distribution and discrepancy theory which have links with many other areas of mathematics such as analysis, algebra, probability theory, geometry and discrete mathematics.

The Number Theory Group has links with the Centre for Advanced Computing – Algorithms and Cryptography (ACAC) in the Department of Computing. A description of the activities of ACAC can be found in the Department of Computing Postgraduate Brochure.

- Applied Mathematics

Applied mathematics is a research area of increasing importance in the Department of Mathematics. The Applied Mathematics Group has interests in wave scattering and imaging, nonlinear dynamics, mechanics and geometry, and the work spans the areas of theoretical modelling, computational modelling and applications, including industrial applications as well as the theoretical development of the mathematical framework of large classes of models. Particular interests include

- the scattering and the detection of acoustic and electromagnetic waves from complex objects with applications to antenna design and to object identification or imaging (inverse scattering);
- the inversion of static field data for the creation of magnetic or gravity profiles for geological purposes; and
- the modelling of nonlinear effects in electronic systems leading to chaos or other dysfunctional behaviour.

Members of the Applied Mathematics Group form part of a University Research Innovation funded team on inverse scattering, remote sensing and data inversion, a consortium of applied mathematicians, electrical engineers and geologists drawn from Macquarie University and the CSIRO. The Applied Mathematics Group has a strong international reputation that is built on significant interactions with other mathematicians, scientists and engineers, in Australia and internationally, and is demonstrated by its work with scientific and industrial organisations, such as the DSTO and the CSIRO, and their overseas counterparts.

Research Interests of Staff Members

- Analysis

- Dr Bonnington Clarke: Hyperbolic partial differential equations, control theory, boundary controllability and observability of linear systems of partial differential equations, hyperbolic differential boundary equations.
- Associate Professor Xuan Think Duong: Singular integrals, functional calculi, Hardy spaces and partial differential equations, harmonic analysis and partial differential equations.

- Dr Christopher Meaney: Harmonic analysis on Lie groups and symmetric spaces.
- Dr Lixin Yan: Singular integrals, wavelet analysis, function spaces, harmonic analysis, partial differential equations.
- Category Theory
 - Dr Michael Batanin: High dimensional category theory and higher dimensional homological algebra with applications to homotopy theory, algebraic topology, deformation theory and combinatorics.
 - Dr Alexei Davydov: Category theory (monoidal categories), representation theory (representations and character tables of finite groups), mathematical physics, algebraic topology and algebraic K -theory.
 - Dr Thorsten Palm: Higher-dimensional categories.
 - Dr Simona Paoli: Category theory, algebraic topology.
 - Professor Ross Street: Category theory with applications to algebraic topology, homotopy theory, knots, combinatorics, group representations and computer science.
 - Professor Michael Johnson (Computing): Category theory with applications to computer science, homotopy theory, and universal algebra.
 - Associate Professor Dominic Verity (Computing): Higher-dimensional category theory and its applications to simplicial/cubical geometries, homotopy theory, non-abelian cohomology, category theory and sheaf representations of rings.
- Number Theory and its Applications
 - Professor William Chen: Uniform distribution, discrepancy theory and analytic number theory.
 - Dr Gerald Myerson: Number theory, finite fields, multivariate polynomials, uniform distribution, Dedekind sums, covering congruences and magic squares.
 - Emeritus Professor Alfred van der Poorten: Number theory, theory of functions, p -adic analysis, transcendence theory, diophantine approximation, diophantine equations, application of computers in number theory.
 - Dr Rodney Yager: Algebraic number theory, the arithmetic of elliptic curves, abelian varieties, Iwasawa theory, p -adic L -functions and their relationship to the arithmetic properties of the associated variety.
 - Professor Igor Shparlinski (Computing): Analytic and computational number theory, finite fields, application of number theory to computer science and to the complexity of computations.
- Mechanics, Geometry, Waves and Nonlinear Dynamics
 - Dr Sergey Panin: Analytical-numerical techniques based on analytical regularization and their implementation in acoustic and electromagnetic theory.
 - Dr Tanya Schmah: Geometric mechanics and symmetry, symplectic and Poisson geometry, nonlinear dynamics.
 - Professor Paul Smith: Geometric mechanics and symmetry. Mathematical modelling of acoustic and electromagnetic waves, analytical and computational methods, nonlinear dynamics in electronic systems. Ordinary and partial differential equations, integral equations.

- Dr Elena Vinogradova: Mathematical modelling of acoustic and electromagnetic wave diffraction, potential theory problems, analytical and numerical techniques, applications to resonant phenomena, antenna design, radar cross section. Direct and inverse scattering problems. Integral and series equations, ordinary and partial differential equations, special functions and integral transforms. Electronic systems models and nonlinear dynamical systems.
- Mathematical Physics
 - Senior Research Fellow Dr John Corbett: Mathematical and conceptual problems of quantum theories, quantum numbers, non-locality and measurement problem, tripartite entanglement, reconstruction problem, spatial toposes, and topos theory models of non-relativistic and relativistic quantum systems. The localisation in quantum space-time. General relativity.
 - Dr Frank Valckenborgh: Lattice theory, projective geometry, category theory.
- Algebraic Geometry, Mathematical Computing and Typesetting
 - Dr Ross Moore: Algebraic geometry, mathematical computing, mathematical typesetting and electronic presentation. Cohomology of vector bundles over projective spaces, Horrocks-Mumford vector bundle. Mathematical computer graphics, computational number theory, chaos, tilings and curves.

Research Scholarships

Applicants with Bachelors degree with First Class Honours, or a Masters degree with a substantial research component, are eligible to apply for a competitive scholarship (APA/MUPGRA/RAACE/APAI/iMURS/IPRS). A recipient of such a scholarship who has a superior ranking may be offered a Divisional supplementary scholarship. The duration of the supplementary scholarship is initially one year, and its renewal is determined by the duration of the “main” scholarship to which it is tied.

Further assistance is available from the Macquarie University Postgraduate Research Fund (PGRF) and the Division of ICS Postgraduate Research Fund (ICS PGRF). These support specific research projects, and facilitate student participation in conferences, colloquia and seminars such as the Australian Mathematical Society Graduate Summer School Programs.

Additionally there may be support in the form of casual employment as a tutor and marker within the Department of Mathematics and the Division of Information and Communication Sciences.

Research Training

As part of their degree requirements, research students take a mandatory coursework unit (MATH843). The primary aim of this unit is to provide students with familiarity and expertise in the use of computing software as used by professional mathematicians in their everyday research and communication. This includes the preparation of journal articles and materials for seminar presentations. Good mathematical writing style will be addressed, as well as the mechanics of how to use LaTeX software to produce desirable printable layouts. The special needs of mathematical, and other technical, material is addressed. Particular requirements of individual students, due to the nature of their research project, will also be handled. This is in addition to handling citations, bibliographies, figures, tables, diagrams, table of contents, indexes, etc. By the end of the course, each student should have prepared a professional quality proposal for their own postgraduate research topic, including literature survey with active hyperlinks to resources available on the internet.

ACADEMIC STAFF OF THE MATHEMATICS DEPARTMENT

Professor of Mathematics and Head of Department

- William Chen, BSc (London), PhD (London), ARCS, DIC, FAustMS

Professors of Mathematics

- Paul Smith, BSc (Adelaide), PhD (Cambridge)
- Ross Street, BSc (Sydney), PhD (Sydney), FAA, FAustMS

Associate Professor in Mathematics

- Xuan Duong, BSc (Ho Chi Minh City), PhD (Macquarie)

Senior Lecturers in Mathematics

- Bonnington Clarke, BSc (Wales), PhD (London), DIC
- Christopher Meaney, BSc (Flinders), MSc (Flinders), PhD (Washington)
- Ross Moore, BSc (Melbourne), MSc (Oxford), DPhil (Oxford)
- Gerald Myerson, AB (Harvard), MS (Stanford), PhD (Michigan)
- Rodney Yager, BSc (Sydney), PhD (ANU)

Lecturers in Mathematics

- Tanya Schmah, BSc (UWA), MA (Bryn Mawr), PhD (Lausanne)
- Elena Vinogradova, MS (Kharkov), PhD (Kharkov)

Associate Lecturer in Mathematics

- Frances Griffin, BSc (Macquarie), MSc (Macquarie)

Research Fellows in Mathematics

- Michael Batanin, BA (Novosibirsk), PhD (Novosibirsk)
- Alexei Davydov, MS (Moscow), PhD (Moscow)
- Thorsten Palm, MSc (Braunschweig), PhD (York, Canada)
- Sergey Panin, MS (Kharkov), PhD (Kharkov)
- Simona Paoli, BSc (Warwick), MSc (Warwick), PhD (Warwick)
- Frank Valckenborgh, MSc (Brussels), PhD (Brussels)
- Lixin Yan, BA (Jilin), MSc (Zhongshan), PhD (Zhongshan)

BRIEF RESUMÉ OF THE ACADEMIC STAFF

Michael Batanin

We all remember from elementary mathematics how to put brackets correctly on an algebraic expression written on a line. But doing the same thing for the expression on a plane or in a space of higher dimension is very complicated task which is tightly related to some deep questions in algebra, geometry and mathematical physics. Michael Batanin is one of the world leaders in the study of this type of problems. He received his PhD in algebraic topology from Novosibirsk State University in Russia in 1987 and worked in Sobolev's Institute of Mathematics until 1996. His main research interests lie in the area of higher category theory, homotopy theory and combinatorics. He has been at Macquarie University since 1996 and is currently a Scott Russell Johnson Research Fellow.

William Chen

William Chen began his academic career at Imperial College London, where he did his undergraduate and postgraduate studies between 1975 and 1981. He was a member of the permanent faculty there between 1981 and 1990, and joined Macquarie University in 1991, where he is now Professor of Mathematics and Head of Department. He is an international leader in the area of irregularities of point distribution and discrepancy theory, and has contributed towards several important breakthroughs. When he is not working, William can often be found indulging in good food and fine wine. He is also President of the Nova Youth Orchestra Association.

Bonnington Clarke

Bon Clarke studied at University College Swansea, a constituent college of the University of Wales, and completed his postgraduate studies at Imperial College London. He joined the Department of Theoretical Mechanics at the University of Nottingham, and came to Macquarie University in 1976. His fields of interest are primarily in the areas of time dependent partial differential equations, principally problems of controllability and observability, both important related topics in systems theory. Outside mathematics, Bon has a lifelong interest in music and occasionally attempts to entertain others on his chosen instrument. He has a serious interest in accurate music reproduction and producing solutions to the associated practical acoustic problems. Other interests include jogging and mountain-biking.

Alexei Davydov

Alexei Davydov started his academic career at Moscow University, where he did his undergraduate, postgraduate and Ph.D. studies between 1982 and 1990. He was a member of the permanent faculty there between 1990 and 1999. He joined Macquarie University in 2000 as a research fellow. He is an internationally recognized mathematician working in the area of algebra, representation theory and category theory. Alexei's other interests include mineralogy, horse riding and scuba diving.

Xuan Duong

Xuan Duong came to Australia in early 1987 as a refugee, and completed his PhD studies in mathematics at Macquarie University in early 1991. After three years working at the University of New South Wales, he came back to Macquarie University where he is now Associate Professor in Mathematics. Duong has made several important breakthroughs in harmonic analysis and partial differential equations. He has been

awarded an Australian Research Council (ARC) Fellowship and two large ARC research grants. He has travelled widely and been invited to give lectures at a number of universities and conferences in Australia and around the world.

Frances Griffin

Frances Griffin returned to study at Macquarie University after many years working as a professional musician in Sydney. She graduated with a masters degree, having specialised in number theory and cryptography, investigating the most efficient ways to fill hard disks with pseudorandom numbers. She now has an interest in the use of technology in mathematics education, and one of her projects is the design, development and implementation of the online quiz system used in many mathematics units at Macquarie. Her interests include photography and cycling, and she can be seen on the bike on weekends tackling the big hills in northern Sydney.

Christopher Meaney

Originally from South Australia, and a graduate of Flinders University, Chris Meaney earned his PhD at the University of Washington in 1979. Prior to his arrival at Macquarie in 1991, he held a variety of research and teaching positions in Dunedin, UNSW, Adelaide, Milan, Austin, and ANU. His mathematical interests are a blend of Fourier analysis, special functions, abstract harmonic analysis, and representation theory. His research collaboration with Italian harmonic analysts is into its third decade. When not immersed in his usual working habitat of cluttered books and papers, he might be found watching Aussie Rules football or a hockey match.

Ross Moore

Ross Moore followed up his undergraduate studies, in mathematics and theoretical physics at the University of Melbourne, with postgraduate work at Oxford University, supported by an “Exhibition of 1851” scholarship. After qualifying for a DPhil, Ross returned to Australia, doing post-doctoral work at ANU for 5 years before moving to Macquarie University in 1986, where he is now a Senior Lecturer. As well as pursuing research in algebraic geometry, Ross has made significant contributions to mathematical typesetting and typography, by devising ways to easily encode the features of complicated mathematical diagrams and figures, for reproduction on the printed page and electronically for websites. He has been on the Board of Directors for the T_EX User’s Group (TUG) since 1997, and is webmaster for both the Australian Mathematical Society and the International Council for Industrial and Applied Mathematics. When away from a computer screen, Ross enjoys good wine, fine music, contract bridge and tennis.

Gerald Myerson

Gerry Myerson has degrees from Harvard, Stanford, and Michigan. He taught at SUNY Buffalo, University of British Columbia, University of Texas at Austin, and Southwest Texas State University before joining the Macquarie Mathematics Department in 1987. He has published papers on equations over finite fields, Mahler’s measure, Dedekind sums, distribution of sequences, magic squares, and musical scales. He sings in a local choir, and presents programs of folk music on a local radio station.

Thorsten Palm

Thorsten Palm began his academic career at Technische Universität Braunschweig, where he did his undergraduate studies between 1991 and 1997. He moved on to York University in Canada, from which he received his doctoral degree in 2003. One year later he joined Macquarie University as a Research Fellow. He works on the theory of

higher-dimensional categories. When he is not working, Thorsten can occasionally be found playing table tennis or other esoteric sports.

Sergey Panin

Sergey Panin is a specialist in developing effective and rigorous analytical-numerical techniques based on analytical regularization and their implementation in acoustic and electromagnetic theory. He received his PhD degree in mathematics and physical sciences from the Institute for Radiophysics and Electronics of NASU in Ukraine in 2003 and worked there until 2004. Sergey joined Macquarie University in 2004, where he is currently Research Fellow in Applied Mathematics. Sergey enjoys running in his free time.

Simona Paoli

Simona Paoli's research is in category theory and algebraic topology, particularly the interactions between higher categorical structures and homotopy theory. Although she grew up in Italy, Simona received all her university education in the United Kingdom. Outside mathematics, she enjoys classical music and mountain hiking.

Tanya Schmah

Tanya Schmah is a well-travelled Canadian/Australian who joined Macquarie University in 2004 after completing her PhD at the Ecole Polytechnique Fédérale de Lausanne in Switzerland and a stint as a lecturer at the University of Warwick. She studies the consequences of symmetry in mechanical systems, in a field called geometric mechanics. More broadly, she is interested in all sorts of dynamical systems, geometry and topology, and modelling of real-world systems. She loves music and the outdoors and a good folk-dance.

Paul Smith

Paul Smith completed his PhD at Cambridge, following undergraduate studies at Adelaide. He was appointed to the Chair of Mathematics at Macquarie in 2002. His previous position was Professor of Applied Mathematics at Dundee, Scotland where he spent some twenty years building an international reputation in modern applied mathematics. He is interested in understanding phenomena in waves and non-linear dynamical systems by a synthesis of novel mathematical analysis, modeling and computation. Such theoretical studies have practical outcomes: he led the team which developed a device for imaging and detecting anti-personnel landmines (it was successfully deployed in Bosnia and elsewhere), and he holds patents for other similar devices. He regularly consults for government and industry in UK, USA and Australia. In his spare time, Paul enjoys music, especially live.

Ross Street

Ross Street did his undergraduate and postgraduate study at the University of Sydney where he submitted his PhD at the age of 22. He was a postdoctoral fellow at the University of Illinois and an assistant professor at Tulane University in New Orleans. He joined Macquarie University and has continued there as a dedicated mathematics teacher and researcher. He is Professor of Mathematics, Director of the Centre of Australian Category Theory at Macquarie University, and a Fellow of the Australian Academy of Science. Ross Street is an international leader in category theory and has produced many new concepts and deep facts. His research has carried him to many countries where he has collaborators. For recreation Ross paddles a kayak, plays the mandolin, and enjoys the Australian bush.

Frank Valckenborgh

Frank Valckenborgh spent his early life collecting masters degrees in biology, molecular biology and theoretical physics at the Vrije Universiteit Brussel, Belgium, living the free life of a student for about ten years. He decided to continue his investigations in theoretical physics for his doctoral research, and he defended his doctoral thesis in 2001, entitled “Compound Physical Systems in Quantum Axiomatics”. He continues to do research on the mathematical and conceptual foundations of physical theories in general and quantum physics in particular, employing a variety of mathematical techniques. At the moment he is a Macquarie University Research Fellow, a three-year position that he may keep until the end of 2006. If he is not thinking about mathematical physics, Frank is likely to be found either in the bush, trying to identify and take the ultimate picture of snakes and other things alive, or in the sea, where he practices the art of scuba diving, desperately searching for even more observations on his growing life list.

Elena Vinogradova

Elena Vinogradova received her PhD degree in mathematical and physical sciences in 1996 from the Institute of Radiophysics and Electronics of the Ukrainian Academy of Sciences. Previously she worked as a research scientist in the Low Temperature Institute, following MSc studies at Kharkov State University, Ukraine. From 1997, she held a Research Fellowship in Applied Mathematics at Dundee University, Scotland, before moving to Macquarie in 2004. Her interests lie in the rigorous mathematical analysis of fields and waves, especially acoustic and electromagnetic waves, and in its applications such as radar and imaging. She is the co-author of a definitive two-volume monograph on these topics, and is a consultant for government and industry.

Rodney Yager

Rod Yager was an undergraduate at University of Sydney, before pursuing postgraduate studies at the ANU and in Paris between 1978 and 1981. He then spent some time as a faculty member at the Massachusetts Institute of Technology and at Oklahoma State University, before returning to Australia to take up a position at Macquarie University in 1986, where he is currently a Senior Lecturer. Rod’s mathematical passion is number theory, with particular interest in the the amazingly rich arithmetic properties of elliptic curves. Rod also has a longstanding interest in the teaching and assesment of secondary school mathematics, and is an active member of his local church.

Lixin Yan

Lixin Yan did his undergraduate studies between 1986 and 1990 at Jilin University in China, and obtained his master degree in 1993 and PhD in mathematics at Sun Yat-Sen University in 1996. He then became a permanent staff at Sun Yat-Sen University. Lixin has worked at Macquarie University since 1999 as a Research Fellow. His research interests are harmonic analysis, wavelets and partial differential equations.

CONTACT INFORMATION

Please feel free to contact the Department if you have any queries.

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