Mathematics and Engineering

Queen's
UNIVERSITY

Applied Mechanics
Computing and Communications
**Systems and Robotics**

Mathematics and Engineering

Modern communications, machine learning, data mining, electrical, mechanical, and mechatronic systems require sophisticated mathematical models and analysis. This unique engineering program meets the challenge – its versatile graduates have the proficiency demanded of an outstanding engineer as well as the exceptional analytical skills acquired through the program's strong training in mathematics. Mathematics and Engineering graduates who choose to continue their education by pursuing graduate studies have a very good track record of entering the best schools in the world. Graduates of the program are eligible for registration as professional engineers, the program having been fully accredited by the Canadian Engineering Accreditation Board since 1967.

PROGRAM OPTIONS
1. Applied Mechanics
2. Computing and Communications
3. Systems and Robotics

All options include a final year engineering project course, for which the students take advantage of the Department's research and computing facilities.
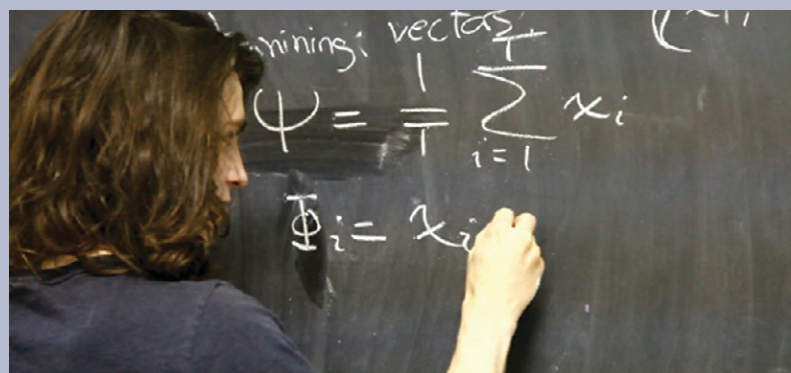
Career and Graduate School Preparation

The graduates of this program have been successful in finding a variety of challenging engineering jobs in fields such as aerospace systems, biomedical engineering, engineering consulting, robotics, software engineering, telecommunications, data analytics and machine learning. As well as finding work in engineering fields, Mathematics and Engineering graduates have also successfully pursued other careers, such as medicine, finance, law, and management consulting. In their jobs, graduates find that their strong mathematical foundation makes them versatile, adaptable, and confident in tackling new challenges. After completing the program, a number of graduates pursue graduate studies in engineering fields as well as in other fields that make strong use of mathematical skills. As is the case with career options, the foundation in mathematics provides them with a competitive edge and enables them to move freely between disciplines.

Applied Mechanics?

The Applied Mechanics option in Mathematics and Engineering blends elements of traditional Mechanical Engineering with the strong mathematics background that all students in the program receive. Students take engineering courses in subjects like mechanics, fluid mechanics, and thermodynamics, as well as tailor made specialized courses, in engineering systems, control theory, and mechanics. These specialized courses are taught at a very high level, and distinguish the Mathematics and Engineering graduates from their traditional counterparts. Graduates are very well prepared for careers in traditional Mechanical Engineering fields, and also have available the flexibility afforded by the exceptionally strong mathematics component of the program.

Emma Hansen, Sci'17,
MSc Candidate,
University of Washington

I'm doing an MS degree in Aeronautics and Astronautics, focusing on optimization and control theory. I have found that in my courses, the rigorous background in mathematics that Apple Math provides is like almost no other program. Many of the courses I have taken at the graduate level have overlapped, sometimes completely, with core courses in the Apple Math program! Yes, Apple Math can be challenging, but the interesting theory you learn, the people you meet, and the professors who are always willing to answer your questions will make it worth your while. I had an amazing experience in the Apple Math program, and would recommend it to anyone interested in mathematics and up for a challenge!
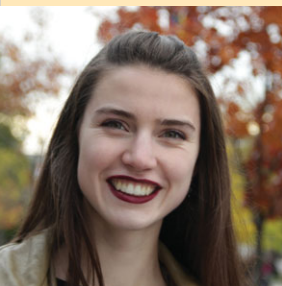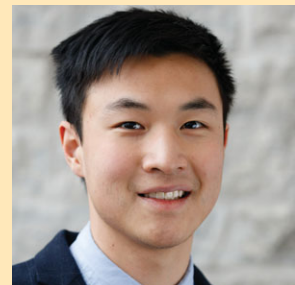
Graeme Baker, Sci'16, MSc'18,
PhD Candidate,
Princeton University

I can think of no better program than Mathematics & Engineering at Queen's to prepare me for my work as a PhD student in Applied & Computational Mathematics at Princeton University. The blend of theory and applications taught me to think analytically and tackle real-world problems using advanced mathematical tools. Apple Math has an extraordinary sense of community; I draw on my experience working with effective and passionate teammates from the program whenever I collaborate with industrial and academic partners. I recommend Apple Math to any engineering student who wants to learn a deep form of problem solving with a spectacular range of applications, both within engineering and beyond.

Daniel Kao, Sci'17,
Analyst,
RBC

The challenge about Apple Math is how best to juggle and enjoy diverse interesting courses while maintaining a healthy university life. This has prepared me for my current work as a currency options trader at RBC, where I am constantly managing complicated first order, second order, and even third order trading risks. These are difficult to juggle all at once while the market is moving to macroeconomic news but I am using the analytical background Apple Math has provided me to learn more and more each day. Perhaps the most valuable thing is the network of Apple Math graduates who are around the world in different career paths doing interesting things.

**Ali Wytsma, Sci'12,
Data Scientist,
Shopify**

The Apple Math program at Queen's is a truly unique program because of the breadth of knowledge that it passes to its students. Students in Apple Math acquire fundamental analytical and problem solving techniques that allow them to thrive in a variety of fields of work and study. Throughout my graduate studies and career the skills I learned in my undergraduate courses in Apple Math have been a great asset. The foundational knowledge of math and systems that I gained in the program has allowed me to succeed in a range of positions: as an analyst in the financial services industry, as a graduate student in machine learning theory, and today as a data scientist at Shopify. This is one of the greatest strengths of the Apple Math program: it nurtures a strong and broad foundation for its students that positions them for success in a range disciplines.

**Russell Taylor, Sci'14,
Software Engineer,
Google**

After graduating Apple Math I did a Masters in Computer Science at Carnegie Mellon University in Pittsburgh. My Apple Math education meant that when I took courses like advanced algorithms, machine learning, and computer vision - all of which are heavily rooted in mathematics - I could understand course concepts on a deep level. After my Masters I joined Google in New York City as a software engineer. Because of my background in mathematics and machine learning I was able to join a team doing very interesting work optimizing Google's online ads business. My experience from Apple Math helps me tackle complex projects, and I still get to apply specific theory from Apple Math courses all the time.

WHY Computing and Communications?
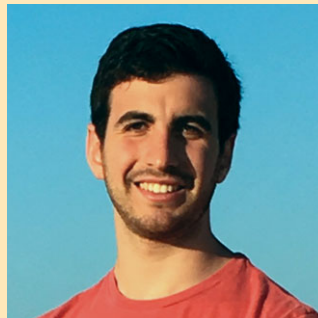
There is increasing demand for graduates with expertise in communications engineering, data science, machine learning and artificial intelligent systems. With the emergence of and proliferation of communication networks, pervasive computing and big data, the demand for mathematically sophisticated data processing algorithms, as well as advanced coding techniques, as regularly attested to in the news, has become paramount. The Computing and Communications option combines basic communication and signal processing systems content with a package of courses in protocols, algorithm analysis, and software engineering methods. Apart from their engineering courses and the background in mathematics, students take high level, program specific courses in engineering systems, communication and information theory, stochastic processes and systems, cryptography, optimization with machine learning applications, and coding theory. Graduates are thoroughly prepared for careers in areas of telecommunications, data analytics, machine learning, and software engineering, as well as having the ability to pursue the wide variety of career options available to Mathematics and Engineering graduates.

WHY Systems and Robotics?

The interface between electrical and mechanical engineering systems is an area that demands sophisticated mathematics and is characterized by the use of refined control methods with electronic/digital implementations, active structural materials, and other topics from classical mechanical design. The Systems and Robotics option blends mathematics, electrical engineering and mechanics into one cohesive program. In addition to the common core of mathematics courses, students in Systems and Robotics take courses in electronics, microprocessing systems, and electric machines from the Electrical and Computer Engineering Department, dynamics and mechanics from Physics, and advanced systems engineering, control, information theory, and optimization courses offered by the Mathematics and Statistics Department. Graduates are very well prepared for careers in robotics, mechatronics, aerospace, control systems engineering, communications engineering and machine learning.

**Adam Cohen, Sci '06, MASc '08,
Android Systems Manager,
Google**

I have very fond memories of my time at Queen's, both in undergraduate and graduate studies in Mathematics and Engineering. I always look back on it as a time of intellectual and personal growth and creativity. The strong foundation in pure and applied mathematics has served me well in my career in engineering and product development, both in my own ventures and now at Google. The abilities to strip problems down to their essential components, challenge assumptions, and build complex systems from well-defined pieces have all served me well, and were fostered in my studies at Queen's. The department was tight-knit, supportive and stimulating and provides a solid foundation for many different career paths, academic or otherwise.
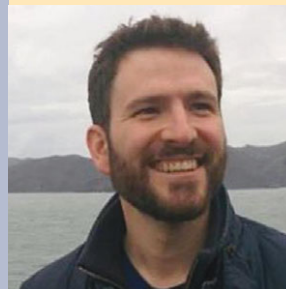
**Jacqueline Craig, Sci'16,
Software Engineer,
Amazon**

After graduating from Apple Math in 2016 I joined Amazon in the Bay Area as a Software Engineer. The skills I have built during Apple Math have become invaluable in a high tech job. Working with interdisciplinary teams each day can produce variability in day-to-day work which includes designing or building software (or hardware), business or leadership discussions, and project management. Apple Math gave me the tools to be successful in each area. Additionally, I discovered that many of my coworkers who completed similar programs (including at a graduate level) were not able to move between disciplines as quickly or communicate as clearly, and their technical knowledge was not as high as mine. The rigour of the program teaches you how to effectively deal with a high learning curve and face uncertainty, assets which were key in accelerating my career.

Tanner Kotsopoulos, Sci'17,
Partner Development Manager,
Microsoft

Apple Math was a tough, yet fun and rewarding three years. I developed the skills of problem solving and of asking the right questions at the right time. I also developed the skills to learn and retain information effectively. I would say that Apple Math takes these skills to the next level, skills that I pride myself for. They indeed have played a huge role in how successful I've been throughout my time at Microsoft and in working with our customers, building relationships and mastering our very broad set of Cloud Technologies (Azure). Luck is when opportunity meets preparation, and Apple Math will definitely prepare you for the future.

Siobhan Powell, Sci'16,
PhD Candidate,
Stanford University

I am working towards my PhD in Mechanical Engineering at Stanford University studying data-driven solutions for the smart grid. My years in Apple Math prepared me extremely well for this. I learned problem solving skills and fearlessness for attacking homework problems. My strong math background opened doors for me in many diverse fields, providing me with all the tools to compete with top students from around the world. My experience in Apple Math made my years at Queen's amazing and really helped shape me into who I am today. I loved being challenged and found the math courses really stimulating. The help and encouragement of the Professors in Apple made me consider applying to grad school in the US, and I'm so grateful for their advice. I would recommend the program 100%!

External Praise for Mathematics and Engineering

The engineering projects that I have read from fourth-year students in the Queen's Mathematics and Engineering program show a level of sophistication that is rare at the undergraduate level. These students will be exceptionally well-prepared for graduate research in a variety of disciplines within engineering and applied mathematics. I hope this program's top students will consider Harvard when applying to graduate school!

Todd Zickler
Associate Professor, School of Engineering and
Applied Sciences, Harvard University

I recently saw two of the 4th year engineering projects that came out of the "Queen's Mathematics and Engineering" program. I am very impressed with the mathematical sophistication of the work. I think the level is a year or two beyond the level of typical good students from US electrical engineering programs and on a par with the level of good students from outstanding Indian and Chinese institutions which, like the "Queen's Mathematics and Engineering" program, really focus on developing the mathematical sophistication of the students. I am confident that there are many areas of graduate study which will find this level of preparation very attractive.

Peter Doerschuck
Professor, Department of Biomedical Engineering, Cornell University