TAKE ON THE WORLD
BE AN ENGINEER

HAJIM SCHOOL OF ENGINEERING & APPLIED SCIENCES AT THE UNIVERSITY OF ROCHESTER

UNIVERSITY OF ROCHESTER
It’s not an easy decision. Enroll in the University of Rochester. And become an engineer. Then the decision may not be as difficult as it appears.

But if you want to make the world a better place—while working with others as part of a team and being amply rewarded for doing so—then the decision may not be as difficult as it appears.

At the Hajim School of Engineering & Applied Sciences, we prepare our students to tackle these great challenges—and to improve our lives—with a “full spectrum” of opportunities. What does that mean? The Hajim School provides students a complete array of engineering to explore, from nanoscale biomedical devices to one of the world’s most powerful ultraviolet lasers.

Hajim School students engage not only in classroom instruction but also in cutting-edge research and hands-on design projects that have real-world applications. They can participate in music, arts, or athletics in addition to their core curriculum. They can study abroad. In other words, we provide students with a rich education and the opportunity to truly grow.

The Hajim School will give you a foundational education, teaching you what you need to know for your first job and how to continue to innovate in a world of accelerating change. Engineers are technology leaders in corporations like Apple, Boeing, Cisco, Google, and Microsoft. Moreover, they also pursue careers in business, law, and medicine. They lead and found major companies. They discover solutions in health care and broadly serve the needs of humanity.

Engineering graduates are not only in high demand but also well rewarded. According to a 2013 report by the National Association of Colleges and Employers, seven engineering majors are among the 10 highest-paid at the bachelor’s degree level.

In these pages, you will read profiles of current Hajim students and testimonials of recent graduates. You will get detailed information about our departments and special programs to help you make the all-important decisions that will help shape your future.

Whether you choose to attend the University of Rochester or elsewhere, choose engineering.

Enroll in the University of Rochester. And become an engineer.
Think for a moment about a video game: Who generates the soundtrack? Someone with the kind of skills offered by this major.

And who will pioneer new ways of searching and retrieving music, not by title or performer, but by its mood or content? Perhaps someone who graduates from this program!

Audio and music engineering is at the intersection of science, engineering, and music. It is a rapidly evolving field where technical and artistic creativity in the sonic and musical arts are combined. And the traditional audio recording engineering profession is rapidly evolving with a burgeoning need for sonic media engineers in emerging areas such as the video game industry. Management of musical content, music information retrieval, music preference engines (such as iTunes and Amazon.com) and the semantic web are thriving industries. Thousands of Internet companies, including Apple, Microsoft, Sony, and Google—as well as music hardware and software companies—are developing audio software for content production, searching and retrieval, and distribution and commerce.

Audio and music engineering is an integral part of many industries, which represent more than $360 billion in economic activity worldwide. The University of Rochester’s audio and music engineering major, offered through a collaboration of the Department of Electrical and Computer Engineering, the College Music Department, and the Eastman School of Music, prepares students to make valued contributions the moment they enter this field. And it prepares them to evolve and grow throughout their careers.

Experiential learning, hands-on design, and the creative process are at the core of the audio and music engineering program. The central pillar of each student’s education is a project portfolio that illustrates the design skills and creative abilities the student has acquired. Started during freshman year, it is capped by a senior design project. Projects might include producing a studio recording, building a vacuum tube amplifier, developing new tools for creating electronic music, or developing software for a cloud-based application or a music transcription program.

Career paths are many and diverse, including computer hardware and software manufacturing, audio software development, music and audio recording and production, audio and signal processing technologies and component manufacturing, musical instruments and audio equipment manufacturing, video gaming, automotive, architectural acoustics, urban planning, industrial noise control, and consumer product design.

Jeremy Hassett’s passion for music has pointed him toward a career in engineering.

The sophomore from Newark, N.Y., who plays electric guitar, arrived on campus undecided about whether to major in music or science.

Halfway through his freshman year, he heard about a class where students were actually building electric guitars. “Wow,” Hassett thought, “that’s really cool.” He’s now enthusiastically pursuing audio and music engineering, a brand new major in the Department of Electrical and Computer Engineering. “I love it. I never thought I would be that interested in electrical engineering—and I started taking the classes.”

He’s intrigued, for example, that software can be programmed to re-engineer and synthesize sound—to “autocompose” music. Or that different plug-ins can change the sounds and how they are mixed. Hassett, who envisions a career in audio software, is also pleasantly surprised at the abundant opportunities—right on the River Campus—to pursue his interest in guitar. He took a Department of Music class in the theory of jazz music, for example, that allowed him to bring along his guitar and learn improvisation techniques.

“There’s a lot of flexibility here in what you can do,” says Hassett, who earned honors on the varsity cross country and track and field teams as a freshman. “If you are at all interested in something, but not really sure if that’s what you want to do, this is a good place to be. You can find where you want to be. And they never make it seem hard for you to switch from one major to another.”
We take pride in offering undergraduate and graduate students ample hands-on opportunities to create exciting health care innovations—such as devising dialysis units small enough to fit in a hand, novel approaches to tissue engineering, and nanoscale drug delivery platforms. In the process, students become directly involved in moving their discoveries from bench to bedside. For example, during our yearlong Senior Design course, students develop prototypes to solve problems presented by local companies, clinicians, or researchers—and also learn about the regulatory process, economic constraints, and ethical challenges. Our new master’s program in medical technology and innovation immerses students in operating rooms and other clinical settings before they begin designing medical devices. Our research is interdisciplinary, enhanced by our close physical proximity to the University of Rochester Medical Center and the Institute of Optics. Seventeen primary and 40 affiliated faculty members work with our students. With 344 undergraduate students enrolled in 2013–14, 40 percent of them women—biomedical engineering represents the largest undergraduate engineering program at the University. Students graduate with career opportunities in advanced research and in industrial and clinical settings. CNN/Money rated biomedical engineering the “best job in America” in 2013, with a median salary of $87,000 and high job satisfaction.

WHAT YOU WILL LEARN
Undergraduates study the following core subjects, plus a sequence of four engineering courses in one of these concentrations: biomechanics, biosignals, cell and tissue engineering, or medical optics.
• Elementary mechanical equilibrium and motion with extended applications to biology
• Computer programming in MATLAB®
• Electrical circuit theory, including bioelectric systems
• Computation and statistics
• Signals, systems, and imaging
• Biomaterials for implants, tissue engineering, drug delivery, and culture
• Quantitative physiology (muscle and nerves, cardiovascular, respiratory, and renal)
• Senior design project

POINTS OF PRIDE
• A tricycle control system devised by our undergraduate students won a prestigious International da Vinci Award. Their Senior Design project enables disabled riders to steer, brake, and shift gears on a recumbent tricycle with one hand.
• Our student chapter of the Biomedical Engineering Society is the first in history to be awarded for excellence in two consecutive years.

Andrew Zeccola has found a way to combine his interest in biology and his knack for building things. “In biomedical engineering, I can do both and help people at the same time,” says the junior from nearby Pittsford, N.Y. For example, during his sophomore year on a research project using near-infrared lasers and detectors to monitor breast cancer therapy. “So many of the professors here are willing to let you in on their research,” he notes. The Department of Biomedical Engineering has the largest undergraduate enrollment in the Hajim School. But Zeccola says he never feels like he’s lost in a crowd. Six or seven students will team up with a teaching assistant in weekly workshops to review material covered in lectures. It’s very easy to get individual attention,” Zeccola says. “Plus, all the professors are very adamant about coming into their offices and asking them questions.” Zeccola, who has earned All-Academic honors with the University’s cross country team, will be team captain his senior year. Division III athletics . . . a strong academic program . . . the close proximity of the University’s Medical Center to the River Campus . . . all lured Zeccola to a university practically next door to where he grew up.

But it wasn’t until he visited as a prospective student that he discovered something else: “It’s a gorgeous campus. I had no idea.”

“ONE OF THE BIGGEST ‘NUGGETS OF KNOWLEDGE’ THAT I HAVE TAKEN WITH ME IS HOW TO THINK. THE PROBLEM-SOLVING MINDSET THAT I HAD TO USE AS A BME MAJOR IS ONE OF THE REASONS I AM ABLE TO WORK EFFICIENTLY IN MY CURRENT ROLE.”
—BETSY SWOVICK ’10
I WENT WITH CHEMICAL ENGINEERING BECAUSE I LOVED CHEMISTRY BUT DID NOT WANT TO GIVE UP MATH. THAT MAY SEEM LIKE A WEIRD ANSWER TO SOME PEOPLE, BUT IT ALLOWED ME TO LEARN A LOT ABOUT THE WAY THE WORLD WORKS AND GAVE ME A NEW PERSPECTIVE ON LIFE AND ON SOLVING PROBLEMS.

—MICHAEL PERITZ '11 (MS '12)

If you are up to tackling such critical challenges as clean energy, biotechnology, and nanotechnology, the Department of Chemical Engineering is for you. We combine chemistry and engineering with the physical sciences, life sciences, mathematics, and economics to find alternative energy solutions, create pharmaceuticals and medical devices, develop new chemicals, and contribute to the creation of food, consumer goods, and electronics.

Undergraduate and graduate students alike are encouraged to participate in such critically important research areas as organic and inorganic photovoltaics, hydrogen and methanol fuel cells, hydrogen and ethanol biofuels, nuclear fusion energy, and medical diagnostics and treatments.

In 2012, we renovated the main undergraduate lab with state-of-the-art equipment and mobile benches. We mean it when we promise to graduate innovative problem solvers ready to explore solutions for a better, safer, and more sustainable world!

An undergraduate degree opens up multiple career options, ranging from working as a professional engineer to using the degree as preprofessional training for fields like law, medicine, or business.

According to a 2013 National Association of Colleges and Employers survey, chemical engineering is one of the best-paying majors, with an average starting salary of $66,900.
Computers play a role in virtually every part of our lives. What career could be more relevant, exciting, and in demand than computer science? The University of Rochester’s Department of Computer Science is an ideal place to prepare for such a career.

The University is embarking on a $100 million program to create an Institute for Data Science. Much of the initiative will be built around the Department of Computer Science, which has long been known for its cutting-edge research.

Faculty and staff help students find paid internships at well-known tech companies such as Google, Microsoft, and Amazon. We maintain strong connections to our alumni, and this provides additional opportunities for our students.

Student projects, including mobile apps, video games, robots, and improved efficiencies in operating systems, are exciting and hands on.

Student teams compete in national and international contests with the help of an active Computer Science Undergraduate Council (CSUG), which also organizes leisure activities and peer tutoring. Other relevant clubs are UR Robotics and RocHack.

WHAT YOU WILL LEARN

• Programming in Java, C++, Ruby, LISP, Python, and other languages
• Theory of computing
• Design of operating systems and programming languages
• Artificial intelligence
• Human-computer interaction
• Advanced classes in computer architecture, natural language processing, computer vision, machine learning, distributed and parallel computing, networks, and mobile and mobile computing

ISABELLE SCHMIT ’16

It’s one thing to talk about how the University of Rochester affords its students the freedom to build their own curriculum. It’s quite another to experience it.

Just ask Isabelle Schmit. The sophomore from New Orleans came to the University of Rochester primarily to study computer science. But she’s also majoring in studio arts “because I can, because it’s fun, and because I have the space in my schedule.”

“They balance each other really well, which is really a cool thing that I probably couldn’t do at any other university.”

Schmit considers the Department of Computer Science a “hidden gem,” with a very collaborative feel. One of her favorite projects involved natural language processing—using a computer to analyze a sentence in English and then convert it to more computer-readable text. This meshed beautifully with a class she was taking as part of her linguistics cluster (see below). “I would look at my computer science notes, then up at the board in my linguistics class and there would be the same diagram. That was mind-blowing . . . I could take two completely different things—engineering and social science—and they felt so interconnected.”

“I still get excited talking about it, and it’s something I would love to learn more about and continue working on,” says Schmit, who has a leadership position in the TOOP student theater group, serves as treasurer of her sorority, and is getting more involved with ROCHack, an unofficial student group that builds websites and apps.

“This is not your typical university,” Schmit says. “You can customize your education. You can really find what you love—and do what you love.”

Rochester computer science students don’t have to take a “mishmash” of required general education classes. Instead, they pick—or design—two three-course clusters within other divisions or departments. This lets them take ownership of their academic program and spend enough time in a field to feel they’ve begun to master it.

“MY SUMMER INTERNSHIP AFTER SOPHOMORE YEAR TURNED INTO A THREE-YEAR CONNECTION THAT INCLUDED OTHER SUMMER INTERNSHIPS, INDEPENDENT RESEARCH, A 3+2 MASTERS DEGREE, AND, Ultimately, A FULL-TIME JOB AFTER I GRADUATED.”

— NATE CHAMBERS ’02 (MS ’03)
Electrical and computer engineering skills are critical in our digital age, in such areas of broad societal impact as health care, energy, national security, and manufacturing and also in telecommunications, consumer goods, media, and entertainment.

The Department of Electrical and Computer Engineering prepares students for these challenges by teaching the fundamentals of circuits and systems, electromagnetics, microelectronics, digital systems, computer architecture, and signals and communications.

Students are encouraged to join faculty members in research that spans a wide range of interests and applications. Recent examples include a computer program that gauges your feelings from your voice and could automatically program a mobile device to play music that fits your mood. Another project involves a motion detector that uses laser light, so that food ads might automatically appear on your cell phone as you go down a grocery aisle.

Most of our graduates either go to graduate school or take industrial positions. We are proud that many of them have had a major impact in fields as different as the microelectronic industry or music.

According to a 2013 National Association of Colleges and Employers survey, computer engineering is one of the best-paying majors, with an average starting salary of $70,300 for bachelor’s degree graduates.

**POINTS OF PRIDE**

Current and previous ECE students have won an Oscar, an Emmy, and a Grammy award. George Borshcherov ’95 (BS EE) received an Oscar in 2000 for his special effects work in the movie The Matrix; Mahmet Kemal Özkın ’92 (PhD) received an Emmy in 1997 for his contributions to the U.S. digital television (DTV) standard; and Stephen Roseman, a current ECE PhD student, received a Grammy Award in 2010 as an engineering/mixing engineer.

**WHAT YOU WILL LEARN**

- Circuits and system analysis
- Digital logic design
- Communications systems
- Semiconductor devices and electronic circuits
- Design and analysis of digital and analog integrated circuits
- Electromagnetic waves and applications
- Computer organization, including modern microprocessor design
- Design and applications of microprocessors and embedded microcontroller systems
- Ethical, social, and safety considerations of the profession
- A capstone design project of the students’ choosing

**Nancy Vargas ’17**

“I’ve always liked technology. I’ve always thought it was kind of magical,” says Nancy Vargas. “When I was younger, I would always wonder ‘How do these things work,’ and want to be able to build them.” Her wish is coming true as a freshman in electrical and computer engineering.

“It’s my first year, and I’m already learning everything from programming to circuits,” she says. “In one of her classes, students built an amplifier. We learned how it works and learned about op amps (operational amplifiers). I thought it was very interesting considering it was my first semester here.”

Vargas is a first-generation college student from San Antonio, Texas—a California native whose parents emigrated from Mexico. She chose the University of Rochester because of its open curriculum. She liked “being able to explore your passions without being tied down to one thing.”

As part of that exploration she took an anthropology class on Latin American immigration to learn more about her culture; that led to another class in anthropology. With help from Associate Professor Daniel Reichman she would like to further her interest in cinematography and photography by doing a documentary about Mexican-Americans.

Vargas is grateful for the opportunities Rochester has given her. “You can always find somebody you want to study with or play quidditch with.”

"ROCHESTER TAUGHT ME TO WORK HARD. I KNOW THAT SOUNDS LIKE A CLICHÉ, BUT COMPARING MYSELF TO COLLEGUEs FROM OTHER SCHOOLS, I SEE THE EASE WITH WHICH I DO MY WORK AT THE HIGHEST LEVEL, WHERE THEY STRUGGLE TO JUST ‘PASS.’"

—MICHELLE LAY SAMS ’02 (MS ’04)
Mechanical engineering undergraduates at the University of Rochester apply the latest software to solve problems of solids and fluids, materials science, mechanical systems, and advanced power. Applications range from the functioning of the human heart to why ancient structures still stand, and from the pursuit of laser fusion to building tunnels where they could never have been built before.

The Department of Mechanical Engineering offers a newly refurbished undergraduate lab and links to research centers around the University, including the Laboratory for Laser Energetics—one of the world’s foremost facilities for studying inertial confinement fusion—the Center for Freeform Optics, and the School of Medicine and Dentistry.

Undergraduates become involved in research projects or summer jobs at these centers, at national organizations such as NASA and Sandia National Labs, and at a wide variety of engineering firms in the Rochester area, such as Corning, Xerox, ITT Exelis, and OptiPro.

Students can gain additional hands-on experience—and have a lot of fun—by joining the Baja SAE team, which builds an all-terrain vehicle each year and competes against more than 100 other university teams.

“Baja really does give students an opportunity to explore all of those different aspects of engineering at the same time,” Green says. “It’s no trouble dropping in for a few minutes for a quick question. That community aspect of it definitely is attractive.”

“I think I’ve hit a steady stride,” he adds. “I’m involved in exciting research. I’m in a leadership position on the Baja team, and I think that experience is going to make me valuable anywhere.”

WHAT YOU WILL LEARN

• Computer-Aided Design (CAD) software for engineering drawings and designs
• Basic concepts, such as distributed loads, internal forces, joints, and sectors
• Thermodynamics
• Finite element analysis to solve design and analysis problems
• Mechanical systems, fluid dynamics, solid mechanics
• Properties of engineering materials, including atomic structure
• Vapor power and gas power systems, refrigeration and heat pumps, internal combustion engines, compressors, and turbines
• Lab practice and data analysis
• Senior capstone project: developing solutions to real-world mechanical engineering problems submitted and mentored by industry and/or faculty

POINTS OF PRIDE

• Professor Riccardo Betti is recipient of the 2012 Department of Energy Distinguished Scientist Award and of the 2009 Edward Teller Medal from the American Nuclear Society.

The department is ranked 14th in publications per faculty and 8th in citations per publication, according to a 2010 study by the National Research Council.

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Optics is all about light: how it’s generated, propagated, manipulated, and detected. Its applications can be found in our everyday lives—barcode scanners, cameras, laser printers, fiber optics communication, and medical imaging—and also in new frontiers such as space telescopes, quantum cryptography, laser fusion, and plasmonics.

There is no better place to prepare for a career in this exciting, constantly evolving field than the Institute of Optics, the first of its kind and internationally renowned for its leading role in such fields as quantum optics and laser physics.

Undergraduates pursue a degree in optics or in optical engineering. They participate in research alongside faculty experts in such emerging areas as quantum optics, nanophotonics, terahertz optoelectronics, and freeform optics. Research at the institute is highly interdisciplinary: optics students may work with researchers at the Laboratory for Laser Energetics, the Department of Physics, or the University of Rochester Medical Center.

The institute fosters a close-knit atmosphere. Networking lunches acquaint students with faculty members. Monthly pizza gatherings help students unwind.

About 30 companies are members of our Industrial Associates Program, which can quickly connect students with internship and job opportunities.

Our graduates typically move on to prestigious graduate schools or receive multiple job offers in academia, industry, and government agencies. An optics graduate with a bachelor’s degree can expect a starting salary of $60,000 to $85,000 depending on location.

WHAT YOU WILL LEARN
- Operation of optical sources and photodetectors, including lasers and light-emitting photodiodes, and optical instruments and their use
- Adiabatic, interferometry, and testing
- Interference and diffraction
- Electromagnetic theory
- Techniques used in mathematical study of optical phenomena
- Quantum mechanics in the context of modern optics and optical technology
- Practical experience through four laboratory courses and a senior project

POINTS OF PRIDE
- The Institute of Optics has granted more than 2,400 degrees, about half of all degrees ever awarded in the field.
- Three books by Institute of Optics faculty members are among the 12 most-cited books ever in physics, according to Google Scholar.

THE TEST EQUIPMENT I USE AT WORK IS SIMILAR TO WHAT I USED IN LABS AT ROCHESTER. I ALSO DO A LOT OF MODELING AND DATA ANALYSIS USING SOFTWARE TOOLS THAT I WAS EXPOSED TO AS AN UNDERGRAD.

—GRETHEN BAUER ’10
The Pantheon in Rome—containing the largest dome ever built with unreinforced concrete—would never have gotten a building permit based on modern structural codes. Yet it still stands, remarkably intact, after 2,000 years. Only part of Hadrian’s Villa, the famed retreat of a Roman emperor, survives. And yet, modern researchers, using advanced computational modeling and a NASA solar database, have uncovered new evidence that the villa’s design created remarkable intersections of shadow and architecture timed to coincide with key moments in the Roman calendar.

There is much to learn—and much yet to discover—about the evolution of technological, architectural, and engineering practices and their relationship to ancient and preindustrial societies and cultures.

The archaeology, technology and historical structures program at the University of Rochester takes an innovative, multidisciplinary approach to study, integrating material from engineering and natural sciences, the humanities, and social sciences.

Students use various methodologies to explore the creation of artifacts, buildings, and infrastructural systems from the first millennium BCE to the 18th century. Students then broaden their understanding of the social and cultural contexts of these creations through courses taught by faculty members from the classics, art and art history, philosophy, earth and environmental sciences, history, and anthropology.

The program can easily be tailored to prepare students for graduate studies in archaeology, architecture, civil or mechanical engineering, art history, classics, or history.

A prominent feature of the program is a research-oriented track that allows students to address issues of interpretation, conservation, and restoration of the world’s cultural heritage, including collaboration with prestigious foreign, academic institutions and opportunities to study abroad.

Projects have included the funereal architecture of Etruscan and Roman Italy, the pre-Hispanic irrigation canals of Northern Peru, a structural analysis of the Great Hall of Trajan’s Market in Rome, and the cobbledstone masonry of western New York.

### WHAT YOU WILL LEARN

- Insights into the material culture and technology of preindustrial societies
- The impact of technology on ancient and preindustrial cultures
- The engineering behind the technology, design, materials, structures, and architecture of historical monuments
- Skills in interpreting, conserving, and restoring historical artifacts, monuments, and infrastructures

### Cassandra Donatelli ’13, T5 ’14

How many people can say they’ve recovered an ancient Roman coin from an archaeological dig in Italy? Or demonstrated that a prehistoric canal in Peru probably never worked because sloppy surveying let a hill get in the way? Or explored how the brain functions differently when people communicate by sign language rather than by voice?

Cassandra Donatelli has accomplished all of that, and more, through the University’s archaeology, technology and historical structures (ATHS) program, followed by a year in the Take Five Scholars Program. She’s also pursued her love of theater by doing a variety of jobs, including Master Electrician, for Rochester’s International Theatre Program.

“I love this school. I’ve been able to take advantage of all these opportunities. I could never do that anywhere else,” says Donatelli, who is from Portland, Maine. She will leave Rochester with a BA in ATHS and three minors: in biology, mechanical engineering, and technical theater. “One of the main reasons I came to this school is because they gave us an opportunity to take a lot of classes not necessarily related to your major.”

She enrolled in ATHS after taking a course on the engineering of bridges with Renato Perucchio, professor of mechanical engineering and the program’s director. “He was so enthusiastic and so excited about engineering that he just drew me in.”

She spent a month at the archaeological site at Torano, Italy, helping excavate a Roman villa under the supervision of Elizabeth Colantonio, assistant professor of religion and classics and ATHS faculty. “It was amazing. It wasn’t like a slow introduction where they didn’t really trust you to do any of the real work. We were actually digging in the trenches.”

For her capstone project, analyzing the prehistoric irrigation canals of Peru, she delved into hydrology with David Foster, professor of chemical engineering; construction technology with Perucchio; and the geology of volcanoes and earthquakes in the area with Cynthia Ebinger, professor of earth and environmental sciences and ATHS faculty.

“It was a great interdisciplinary experience,” Donatelli said.

Her next stop: Tufts University in Boston in pursuit of a PhD in biomechanics, an area she studied during an NSF-funded undergraduate research internship at the University of Washington last summer. The decision to pursue that line of study came easier, she says, because of her many and varied explorations at the University of Rochester.

“I was able to take all these courses and minors and my major and actually get to see what I was actually interested in,” Donatelli says. “Now I feel solid and comfortable in my choice to go to graduate school.”
University of Rochester’s Laboratory for Laser Energetics, established in 1970 to investigate the interaction of intense radiation with matter, is a unique national resource. It houses Omega, the world’s most powerful ultraviolet laser system, and pursues the feasibility of inertial confinement fusion as an inexhaustible energy source.

Education is one of its most important missions. More than 800 Rochester students have received training at LLE—in electro-optics, high-power lasers, high-energy density physics, plasma physics, and nuclear fusion technology. And that means unique opportunities for students in the Hajim School of Engineering & Applied Sciences. During 2013–14 for example, 30 Hajim School undergraduates worked at LLE on a variety of projects.

Student projects included operational maintenance of the Omega Laser Facility; work in laser development, materials, and optical-thin-film-coating laboratories; computer programming; image processing; and diagnostics development. Students have the unique opportunity of working with some of the world’s leading scientists and engineers, not just from the University of Rochester but also from other research and technology laboratories worldwide.

LLE’s program for undergraduates is a unique opportunity for students, many of whom will go on to pursue a higher degree in the area in which they gained experience at the laser lab. Other students have started their own companies, crediting their hands-on experience at the laser lab as a turning point in their academic careers.

Cerium oxide—a critical material used to make precision optics—is only available from foreign sources. Export restrictions have caused major price swings, and this has resulted in significant cost uncertainties for optics manufacturers, several of which are in the Rochester region.

Tess Jacobs, a Hajim School undergraduate, is helping to find a solution at the Laboratory for Laser Energetics. The Institute of Optics junior is working with two Rochester companies, testing the relative effectiveness of two different methods for removing wastes from a polishing slurry that contains cerium oxide, so that it can be recycled, after it is used. Her project, supervised by Professor Stephen Jacobs, is funded by the U.S. Department of Energy.

“I do a couple of experiments on the slurries, comparing the original and the recycled ones to see how they chemically differ,” she explains. No, she doesn’t get to use LLE’s renowned Omega laser, but she is getting hands-on experience with optical polishers and metrology equipment, such as white light interferometers. “It’s really interesting,” she says.

Jacobs, who is from San Jose, Calif., eventually would like to earn a graduate degree at the institute and then look for a career in medical optics. “There’s a lot of really promising, emerging fields for optics, especially in medical care—for example, early, noninvasive detection of breast cancer.”

She appreciates the close-knit, supportive environment at the institute. “Some of my professors have done really groundbreaking research, but I can still go in and chat with them about a simple physics problem. I really like that. I think that’s pretty unique to Rochester.”

So is the LLE, where Jacobs is doing research that makes a difference.
Abner Aquino ‘16

A lot of freshmen start college not knowing what to expect. Not Abner Aquino, who discovered that the University of Rochester’s Early Connection Opportunity program is a great way to “ease into the curriculum.”

Now a sophomore in electrical and computer engineering, Aquino arrived on campus the summer before his freshman year for instruction in math, basic engineering, writing, and time management/study skills. A series of seminars introduced students to campus life and services.

“I would definitely recommend it,” says Aquino. It gave him an upper hand compared to many of his freshmen classmates, he adds.

Classes in robotics, mechatronics, and auto-cad at his Brooklyn high school hooked Aquino on engineering. At the University of Rochester he’s found supportive professors and staff in the Department of Electrical and Computer Engineering.

He also enjoys additional hands-on experience by working on audio equipment at the University radio station as part of WRUR Engineering and by participating in “fix it” nights with the student IEEE chapter.

As a Kearns Scholar, he is afforded academic advising, study groups, career mentoring, and other enrichment opportunities. “The program provides another source of guidance along with helping me plan and prepare for graduate school,” Aquino says.

Aquino has taken full advantage of the University’s flexible curriculum to explore interests outside engineering. He’s taking classes in religious history, for example, and American Sign Language. He’s active on the rugby team.

“The University of Rochester,” says Aquino, “has everything you could possibly need—good faculty, a good support team, and plenty of opportunities for you to grow and learn.”

Louisa Bauer ’14

Mention the Comeragh Mountains of Ireland to Louisa Bauer and don’t be surprised if the BME senior gets a faraway look in her eyes.

One of her fondest memories of her Study Abroad semester in Dublin was a weekend spent hiking in County Waterford.

“That was great,” she recalls. “You’re with a small group of people, and you’re hiking through beautiful mountains. I made some really good friends there.”

Bauer spent the spring semester of her junior year at Dublin’s Trinity College. It took a lot of work to arrange this once-in-a-lifetime opportunity, but it was definitely worth it, she says.

It’s been an important part of her “full-spectrum” experience at Rochester, including:
• Two years of varsity soccer
• Invaluable experience as a teaching assistant for two classes
• Hands-on research experience developing a new way to target leukemia stem cells with chemotherapy
• An entire summer doing lab work through the Xerox Engineering Research Fellows program

All that lab time will be good training when she looks for a clinical research coordinator position after graduating, before going on to med school.

But she’ll also draw on her experiences from that memorable semester abroad. “I think I’ve become a lot more confident and able to talk to people more easily,” she says. “You’re sort of forced to make friends pretty quickly.”
FAST FACTS

BY ANY MEASURE, THE HAJIM SCHOOL IS ON THE MOVE.
Our undergraduate enrollment has nearly doubled from 710 in 2007–08 to 1,337 in 2013–14.

According to the report Engineering by the Numbers, published by the American Society for Engineering Education, the University of Rochester’s Hajim School of Engineering & Applied Sciences is ranked:

118th in the percentage of master’s degrees awarded to women by school
29th in research expenditures by school with $32.3 million
The Hajim School of Engineering & Applied Sciences’ graduate programs are nationally ranked 37th by U.S. News and World Report’s America’s Best Graduate Schools as ranked in 2014.

OF THE APPROXIMATELY 1,337 FULL-TIME ENGINEERING UNDERGRADUATES IN THE 2013–14 ACADEMIC YEAR:
29 percent are women
10 percent are underrepresented minorities
16 percent are international students

OF THE 220 BACHELOR’S DEGREES AWARDED IN 2014
27.7 percent went to women
6.4 percent went to underrepresented minorities
12.7 percent went to international students

OF THE GRADUATING SENIORS IN 2013
44 percent went on to full-time graduate programs
16 percent earned humanities/social science minors
5 percent participated in the Take Five Scholars Program or the Kauffman Entrepreneurial Year (KEY) Program

THE HAJIM SCHOOL OF ENGINEERING & APPLIED SCIENCES HAD 87 TENURE/TENURE-TRACK FACULTY IN THE 2013–14 ACADEMIC YEAR:
2013–14 faculty award counts

11—National Science Foundation CAREER Awards
1—Presidential Early Career Award in Science and Engineering (PECASE) (Department of Defense)
4—National Academy of Engineering memberships
115—Fellows
4—Fulbright Fellowships
4—IBM Fellowships
1—Willis E. Lamb Award for Laser Science and Quantum Optics
1—Office of Naval Research (ONR) Young Investigator Award
1—Wolf Prize in Chemistry
1—Ernest Orlando Lawrence Award
9—American Association for the Advancement of Science (AAAS) Fellows

UNIVERSITY OF ROCHESTER
About 23 percent of undergraduates (Arts, Sciences & Engineering) graduated with double majors or with two or more undergraduate degrees in 2013.
18 percent of full-time engineering students took music lessons or courses during the 2013 fall semester

According to a 2013 survey of rising Hajim seniors in the Class of 2014, 97 percent had one or more career-related experiences, 96 percent had two or more career-related experiences.

MAJORS AND GRADUATE DEGREES

Alternative Energy: MS
Audio and Music Engineering: BS
Biomedical Engineering:* BS, MS, PhD
Chemical Engineering:* BS, MS, PhD
Computer Science: BA, BS, MS, PhD
Electrical and Computer Engineering:* BS, MS, PhD
Interdepartmental Engineering: BS
Engineering Sciences: BA
Geomechanics: BS
Materials Science: MS, PhD
Mechanical Engineering: BS, MS, PhD
Optical Engineering: BS
Optics: BS, MS, PhD
Technical Entrepreneurship and Management (TEAM):† MS

* Accredited by the Accreditation Board for Engineering and Technology
† Offered jointly by the Simon Business School and the Edmund A. Hajim School of Engineering & Applied Sciences and administered by the University of Rochester Center for Entrepreneurship

MINORS

Biomedical Engineering
Chemical Engineering
Computer Science
Electrical and Computer Engineering
Environmental Engineering
Materials Science
Mechanical Engineering
Optics

INTERDISCIPLINARY DEGREE PROGRAMS

BS in Cognitive Science: studies in behavioral, computational, and neuroscience approaches to cognition, with an option for coursework in computer science

Joint PhD in Computer Science and Brain and Cognitive Sciences: this program supports interdisciplinary PhD research in computational models of cognition

BS in Geomechanics: designed for students interested in the quantitative aspects of the earth sciences
SPECIAL PROGRAMS

ENGINEERS are the magicians behind the curtain of technology, tackling the grand challenges that face our society.

We invite you to challenge yourself.

SPECIAL PROGRAMS

GRADUATE ENGINEERING AT ROCHESTER (GEAR)
To begin a career in engineering, it helps to have both a bachelor’s degree and a master’s degree, which would typically take at least six years of college, plus a strong score on the Graduate Record Exam (GRE) or Graduate Management Admission Test (GMAT). The GEAR program allows you to skip the exam and earn both your bachelor’s and master’s in just five years. [http://enrollment.rochester.edu/specialized/gear/?tab1]

TAKE FIVE SCHOLARS
Heralded by the New York Times as “one of the most innovative liberal arts programs in the country,” this option allows students to study, tuition free, for an additional semester or year in areas outside their formal majors. [www.rochester.edu/college/CCAS/students/opportunities/takefive/]

STEM-GEMS
Helps underrepresented minorities through the first year of college—and beyond [www.hajim.rochester.edu/undergraduate/stemgems/index.html]

INDUSTRY PRACTICUM CO-OP PROGRAM
Provides quality workplace experience through paid, full-time employment. [www.hajim.rochester.edu/options/ip.html]

KEY (Kaufmann Entrepreneurial Year) Program
Allows students to continue their studies tuition-free for as much as an entire academic year to pursue entrepreneurial endeavors with the help of the Hajim School of Engineering & Applied Sciences and Simon Business School faculty. Students pursue internships, special projects, business plan development, research into various factors for a successful entrepreneur, or analysis of how culture and public policy influence entrepreneurial activities. [www.rochester.edu/college/CCAS/AdviserHandbook/KEY.html]

STUDY ABROAD
Enables students to take science and engineering classes abroad during the academic year. [www.hajim.rochester.edu/undergraduate/studyabroad/intro.html]

TRAVEL GRANTS
Allow undergraduate engineering students to attend professional conferences. [www.hajim.rochester.edu/assets/pdf/TravelGrantapplication.pdf]

XEROX UNDERGRADUATE FELLOWS PROGRAM
Allows engineering undergraduates to participate in a research experience during the summer preceding their senior year. [www.rochester.edu/college/kearnscenter/Xerox/xeroxfellowsmain.html]

MEDICAL TECHNOLOGY AND INNOVATION
Immerses master’s students in clinical settings and then puts them to work designing new medical devices and procedures [http://cmtr.rochester.edu/]

TECHNICAL ENTREPRENEURSHIP AND MANAGEMENT (TEAM) MASTER’S PROGRAM
Immerses students in a technical concentration of their choice while receiving a strong foundation in entrepreneurial management. [www.rochester.edu/team/]

“I worked in the biodiesel lab my junior and senior years and decided to devote a fifth undergraduate year in the Kaufmann Entrepreneurial Year Program to improve the sustainability in the lab. I highly recommend the KEY program to anyone who has a vision of a project that they would like to pursue. The scholars’ projects range from science to dance to t-shirt pressing, or so it did when I was a scholar!”
—Kathleen Maloney ’10 Biomedical Engineering

“When employers [that I interviewed with] found out that TEAM students are not just typical engineers—they also understand business concepts and strategies—that made me even more attractive to hire.”
—Jack Chang ’09 Optics, TEAM Class of 2010
“Professor John Lambropoulos, chair of the mechanical engineering department, was monumental in helping me make study abroad a reality by working with me to find courses that would satisfy graduation requirements. He has been very enthusiastic about students studying abroad, and any mechanical engineering student should seek him as a resource.”
—Jen Skevington ’11, Mechanical Engineering

“Rochester is unique in how many undergraduates can find research positions in the labs on campus, and it’s these opportunities that will help you decide if research is something for you.”
—Lisa Cole ’10, Biomedical Engineering

“When I was looking at schools, I had narrowed my interests to computer science and psychology. I was putting schools into those two buckets as well. When I visited the University of Rochester and talked to the chair of the computer science department, he said to me, ‘Why don’t you come here and study both?’ The thought had never even occurred to me. The Rochester curriculum made it not only possible, but it was encouraged.”
—Brad Orego ’11, BS Computer Science/BA Psychology

“When I was a sophomore, I was able to land a position as a part-time research assistant in J. H. David Wu’s lab. He set me up with a PhD student as a mentor, and he taught me a tremendous amount of molecular biology skills that I could not have learned in class. When I was a senior . . . Professor Wu brought in a speaker from Bristol Myers Squibb. I approached the speaker afterwards, and, next thing I knew, I was working in the industry and have been here ever since. I am sincerely grateful for Professor Wu’s help in getting me into my career.”
—Jason Condon ’04, Biomedical Engineering

“Explore! It’s very easy to get “trapped” on the River Campus and never realize that Rochester is a vibrant, exciting community. Spend time in the city (e.g., downtown, Park Avenue, Corn Hill), visit the Finger Lakes, bike along the Erie Canal path, hike Letchworth State Park, ski Holiday Valley. Play!”
—Owen Zacharias ’03 (MS ’04), Electrical and Computer Engineering

“Since graduating, I’ve realized how interconnected the wider research community really is. It turns out that people with connections to the University are everywhere, so I’ve met plenty of fellow students (and a professor) here who previously studied at the University of Rochester. There’s even a plaque with the bust of George Eastman outside of a classroom here, and students rub his nose for good luck before exams.”
—Kyle Murray ’12, Computer Science (pursuing a PhD at MIT)

“I was interested in the University of Rochester for the strong engineering department, the location, and the volleyball program. I was sold once I visited campus. Walking around the quad, I realized that the campus was exactly how I’d dreamed a college campus would be.”
—Sarah Provan ’05, Biomedical Engineering

For more information, please contact
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