



Graduate programs in  
**ELECTRICAL AND COMPUTER  
ENGINEERING**



**MARQUETTE**  
UNIVERSITY

Be The Difference.



# Why graduate studies in Electrical and Computer Engineering at Marquette?

You'll have access to everything you need to earn your degree and succeed in your career — faculty, computers and labs and strong industry connections and job opportunities. With convenient evening classes and the choice of a full- or part-time schedule, you'll also have the flexibility to learn at your own pace. You even can pursue a career and a degree at the same time, if you choose.

**Be plugged in.** Class sizes are small, and faculty members are readily available and accessible, ensuring a high level of attention to your needs and interests.

**Be a contributor.** Our faculty pursue industry-leading field research in a wide range of areas, including systems/controls, electric energy systems, nano-technology, optimization, theory, time-series data mining, speech and signal processing, electromagnetic scattering, and smart sensor systems. You'll work alongside them, developing the research skills you'll need to make your own lasting contribution to the field.

**Be specialized.** We offer an abundance of specialization possibilities, giving you great flexibility when it comes time to find a career. From algorithms and machine learning to communications and signal processing, solid-state devices and more, the choice is yours.

**Be state of the art.** Outstanding laboratory and computer facilities give you an edge in course work and research.

**Be supported.** We offer generous benefits to an average of nine new students every year in the form of research assistantships or teaching assistantships with tuition credits, a competitive stipend and health care benefits.

## Electrical and computer engineering graduate programs:

Doctorate

Master of science

Certificates: sensors and smart sensor systems, digital signal processing, microwaves and antennas, and electric machines, drives and controls

## ABOUT MARQUETTE

**Our programs.** Marquette offers 20 doctoral degree, 38 master's degree and more than 10 graduate certificate programs with a variety of specializations to help you tailor the curriculum to your needs — an opportunity not offered by all universities.

**Our students.** We enroll approximately 3,500 graduate and professional students from diverse cultural and educational backgrounds and 53 countries all over the world.

**Our faculty.** Marquette's almost 700 full-time faculty represent renowned scholars and industry experts. As a student, you'll also benefit from established collaborations within the local business and nonprofit communities, as well as other nationally renowned institutions within the region, including the Clinical and Translational Science Institute, Medical College of Wisconsin, Milwaukee School of Engineering, University of Wisconsin system, and others.

**Our research.** Graduate students can participate in important research alongside our renowned faculty members — making you a contributing member of our research team, not just a face in the crowd like at some other universities. Marquette faculty applied for significantly more federal grant dollars during fiscal year 2009 than in previous years, and externally funded research requests exceeded \$35 million for the first time. Federal, state, foundation and corporation research awards all increased in fiscal year 2009, and corporate research dollars increased more than 50 percent from the previous fiscal year.

**Our commitment.** Every student receives personalized attention at Marquette with an average class size of 10 students.

**Our network.** As a graduate of Marquette, you'll become part of our alumni family of 110,000 around the world — creating a professional network that spans from right next door to across the globe.

**Our values-based education.** As a Jesuit institution of higher education, Marquette continues a centuries-old tradition of academic excellence, development of the whole person and research that addresses societal needs.

## YOUR JOURNEY

At Marquette, we offer a graduate degree specific in title and practice to electrical and computer engineering, not just a concentration. So you know the knowledge you gain in our up-to-date laboratories, classrooms and centers will be immediately applicable on the job. Plus, if you're already working in the industry, a graduate degree gives you greater ability for career advancement and a salary increase (average of \$11,000 from baccalaureate degree to master's degree).

### Doctoral degree

Applicants (2009): 22

Admitted students (2009): 20

#### Course work:

- Students must complete a minimum of 24 credit hours (eight classes) beyond the master's degree, plus 12 dissertation credits, pass the doctoral-qualifying exam, and submit and successfully defend a dissertation.
- Full-time students typically enroll in seven to nine credit hours (two to three classes) per semester to complete their degree work in as few as three years beyond the master's degree.
- Part-time students typically enroll in three to six credit hours (one to two classes) per semester to complete their degree work in six years.
- Early in the program, students focus on fundamental course work.
- Later in the program, students work closely with their advisers to conduct cutting-edge research and develop their thesis topics.

#### Required courses:

- All students must successfully complete advanced engineering mathematics and probability and random processes in engineering.
- Full-time students must participate in a weekly colloquium.

“

I have had the opportunity to work with numerous professors in the Smart Sensors Group. The genuine interest of my adviser and his mentorship has helped me grow professionally and personally.”

**Arnold Mensah-Brown, Grad '07**  
Graduate assistant  
Department of Electrical  
and Computer Engineering



#### Scheduling:

- Most classes are offered twice a week on weeknights.
- Occasional once-a-week classes are offered.

#### Comprehensive exam:

- All students are required to pass a doctoral-qualifying exam.

For more program details, including requirements and course descriptions, see the *Graduate Bulletin* at [marquette.edu/grad](http://marquette.edu/grad).

Refine your teaching skills, participate in university committee work, present scholarly lectures and papers, and learn how to conduct a successful job search through our Preparing Future Faculty program. Marquette is one of only 17 U.S. universities to have received funding for this program. For more information, visit [marquette.edu/pff](http://marquette.edu/pff).

## Master of science

Applicants (2009): 40

Admitted (2009): 25

### Course work:

- Non-thesis program
  - Students must complete a minimum of 30 credit hours (12 classes) and pass a written comprehensive exam.
  - Part-time students taking three credit hours (one class) per semester typically complete their degrees in as few as three years.
  - Full-time students taking nine credit hours (three classes) per semester typically complete their degrees in two years.
- Thesis program
  - Students must complete a minimum of 24 credit hours (eight classes), plus six credit hours of thesis work, submit an approved thesis and pass a final oral comprehensive exam.
  - Full-time students taking nine credit hours (three classes) per semester typically complete their degrees in two years.

### Required courses:

- All students must successfully complete advanced engineering mathematics and probability and random processes in engineering.
- Full-time students must participate in a weekly colloquium.

### Scheduling:

- Most classes are offered twice a week on weeknights.
- Occasional once-a-week classes are offered.

For more program details, including requirements and course descriptions, see the *Graduate Bulletin* at [marquette.edu/grad](http://marquette.edu/grad).

## Certificate

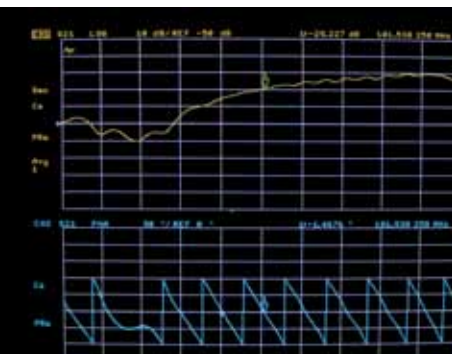
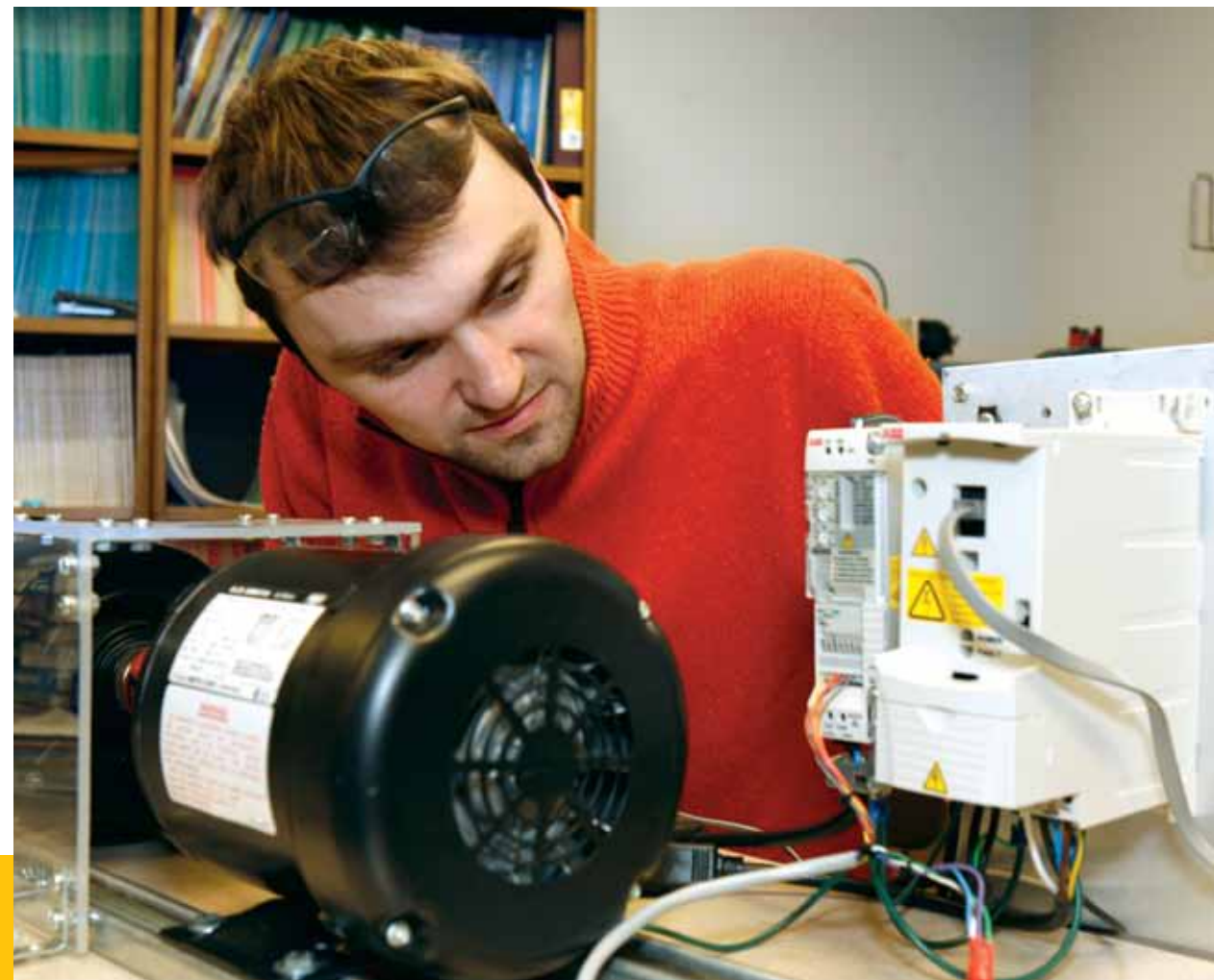
### Areas of study:

- Sensors and smart sensor systems
- Digital signal processing
- Microwaves and antennas
- Electric machines, drives and controls

### Course work:

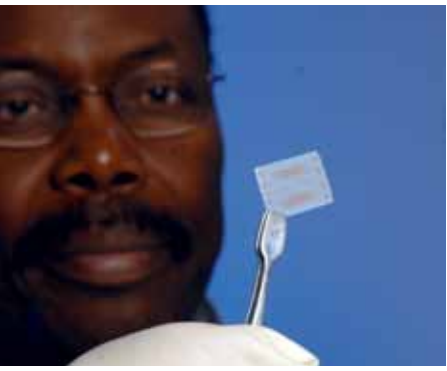
- Students must complete 12 credit hours (four classes).
- Part-time students can complete their certificate in as few as three years.
- Students must earn a grade point average of at least 3.0 with no grade below a C.
- Most courses are offered twice a week on weeknights.

For more program details, including requirements and course descriptions, see the *Graduate Bulletin* at [marquette.edu/grad](http://marquette.edu/grad).



Marquette's GasDay Laboratory, developed by Dr. Ronald H. Brown and engineering students, serves 21 of America's largest utilities and forecasts more than 20 percent of the nation's natural gas usage. It is staffed and operated by Marquette students and faculty. Find out more at [gasday.com](http://gasday.com).

## YOUR FACULTY MENTORS



For more information about the department's faculty, including research, affiliated, adjunct and emeriti members and their research interests, visit [marquette.edu/eece/faculty](http://marquette.edu/eece/faculty).

**Dr. Ronald H. Brown**, director of GasDay and associate professor  
*Intelligent controls; adaptive controls; prediction and filtering; artificial neural networks; genetic algorithms; time-series modeling and ensemble modeling in identification*

**Dr. George F. Corliss**, professor  
*Scientific computation and mathematical modeling; guaranteed enclosures of the solutions of ordinary differential equations; industrial applications of mathematics and scientific computation; numerical optimization; automatic differentiation; high-performance computing and software engineering*

**Dr. Nabeel A.O. Demerdash**, professor  
*Electrical machines and drives; computational electromagnetics/finite elements; power electronics; power systems; fault diagnostics; prognostics and self-mitigation for energy systems*

**Dr. Xin Feng**, associate professor  
*Optimization theory and applications; artificial neural networks; fuzzy systems; time-series analysis and system identification; heuristic algorithms*

**Francis X. Jacoby, P.E.**, associate department chair and adjunct associate professor  
*Machines and drives*

**Dr. Michael T. Johnson, P.E.**, director of graduate studies and associate professor  
*Speech processing; speech recognition and enhancement; natural language processing; signal processing; bioacoustics; microphone array processing; signal enhancement; pattern recognition and machine learning; statistical estimation and classification*

**Dr. Shrinivas G. Joshi**, professor  
*Acoustic wave devices and solid-state sensors*

**Dr. Fabien J. Josse**, professor  
*Solid-state and acoustic wave sensors (chemical sensors, biochemical sensors, biosensors); Micro-Electrical-Mechanical Systems (MEMS) devices and sensors; optical wave-guide-based sensors; smart sensor systems*

**Dr. Chung Hoon Lee**, assistant professor  
*Micro-/nanoscale device fabrication; characterization and analysis; ultrasonic/bio MEMS; microfluidics; thermal analysis of bio/chemical molecules; molecular electronics; thermoelectric material design; fabrication and analysis; near-field scanning optical microscopy; atomic force microscopy probe developments; bio/chemical sensors*

**Dr. Richard J. Povinelli, P.E.**, associate professor  
*Time-series data mining; dynamical systems; chaos; nonlinear signal processing; machine learning; evolutionary algorithms; financial engineering*

**Dr. James E. Richie**, associate professor  
*Electromagnetic scattering; antennas and wave propagation; indoor propagation; numerical techniques*

**Susan A. Riedel, S.M., P.E.**, associate professor  
*Mathematical models of physiological systems that control posture and gait; assessment of abnormal posture and gait in children; design and implementation of undergraduate teaching materials*

**Dr. Susan C. Schneider**, director of undergraduate studies and associate professor  
*Evaluation of the electrical properties of electronic materials for use as sensors; interactions between mechanical and electromagnetic properties of materials; bulk and surface acoustic waves; analog circuit design; analog signal processing; algorithms and implementation; educational methods; generation and modeling of electromagnetic fields*

**Dr. Edwin E. Yaz, P.E.**, department chair and professor  
*Modeling, analysis, estimation and control of stochastic, nonlinear/chaotic and uncertain systems; nonlinear and statistical signal processing; applications of control and signal processing to smart micro systems and fault diagnostics; prognostics and self-healing in electric energy systems.*

## FACULTY RESEARCH

Our department has six teaching laboratories and 13 research labs and centers run by faculty and used by EECE students. We also have many internationally recognized faculty covering diverse research interests who have received individual grants from the National Science Foundation, Department of Defense, Department of Education and a variety of industrial sources. Current research areas include:

### Signal processing

**Drs. Ronald H. Brown, Xin Feng, Michael T. Johnson, Richard J. Povinelli and Edwin E. Yaz**

Research incorporates a wide range of areas, including statistical, nonlinear and multi-dimensional signal processing. Focus applications include time-series forecasting, signal enhancement and noise reduction, speech recognition and enhancement, biological signal classification, and energy systems diagnostics and prognostics.

### Control theory

**Drs. Brown, Feng, Susan C. Schneider and Yaz**

Research centers on the areas of intelligent and adaptive controls, stochastic estimation, and nonlinear and chaotic controls. Application goals include consumption modeling and forecasting, secure communications, and controls for electric energy systems.

### Electromagnetic fields and waves

**Drs. Nabeel A.O. Demerdash and James E. Richie**

Research consists of computational electromagnetics, electromagnetic scattering, antennas and wave propagation, and interactions between mechanical and electromagnetic properties of materials. Targeted applications include finite element models of electromagnetic devices and antenna characteristics modeling.

### Power and energy systems

**Drs. Demerdash and Yaz**

Research focuses on modeling and analysis of electric machines and drives with application to diagnostics and prognostics in electric energy devices and renewable energy systems.

### Solid-state devices and sensor systems

**Drs. Shrinivas G. Joshi, Fabien J. Josse, Chung Hoon Lee and Schneider**

Research includes the areas of solid-state, acoustic wave, Micro-Electrical-Mechanical Systems devices, nanoscale device fabrication and characterization. Key applications include chemical and biochemical sensors and development of nanoscale devices and technology.

### Algorithms and machine learning

**Drs. Brown, George F. Corliss, Feng, Johnson and Povinelli**

Research focuses on computational techniques such as statistical pattern recognition, neural networks, evolutionary algorithms and high-performance computing with applications to important problems, including time-series forecasting and prediction, automatic speech recognition, data mining, financial engineering, and mathematical modeling of biological systems.

For more information about the department's faculty, including research, affiliated, adjunct and emeriti members and their research interests, visit [marquette.edu/eece/faculty](http://marquette.edu/eece/faculty).

## YOUR RESOURCES

As a graduate student in electrical and computer engineering, you'll have access to:

- six teaching laboratories and 13 research labs run by faculty and used by students, including:
  - high-tech renewable energy lab
  - motors and drives lab
  - new nanotechnology lab
  - sensors lab
  - speech-processing lab
- the College of Engineering's new state-of-the-art Discovery Learning Complex

Our graduate programs also provide excellent resources beyond the classrooms. Thanks to our location in downtown Milwaukee and community-connected faculty, you'll enjoy an urban setting with access to a vibrant arts scene, professional sports, restaurants and nightlife.

### Marquette University

- Access to networking, career counseling, and job searching counselors and seminars through our free Career Services Center
- More than 20 academic centers and institutes that foster research in end-of-life care, ethics, neuroscience, rehabilitation engineering, transnational justice, water quality, sports law and others
- Access to more than 1.7 million volumes of books and bound journals, 22,000 journals and other serials in digital format, laptops for checkout, and extensive special collections (Raynor Memorial Libraries are open evenings and weekends)
- Access to a secure high-speed wireless network (54Mbps) for laptops and other devices
- Remote computer access to campus-only resources through our VPN
- Student Health Service, Counseling Center and Campus Ministry
- Sports recreation and fitness facilities
- Big East Conference sports, including men's basketball, which has 27 NCAA appearances, 14 Sweet Sixteen appearances, three Final Four appearances and one NCAA championship (1977) and plays in front of 18,000 fans at the Bradley Center

### Milwaukee

- The Milwaukee metropolitan area has approximately 1.7 million people, ranking among the top cities in the United States by population
- Home to 10 fortune 500 company headquarters, including Harley-Davidson, Johnson Controls, Northwestern Mutual and Rockwell Automation
- Milwaukee offers many art and cultural opportunities, including a repertory theatre, a symphony orchestra, two opera companies, a ballet company, diverse art galleries, a public museum, the Milwaukee County Zoo and the Milwaukee Art Museum
- Professional sports include baseball (Brewers), basketball (Bucks), hockey (Admirals), soccer (Wave) and skating exhibitions at the Pettit National Ice Center (an Olympic training facility)
- Known as the city of festivals, Milwaukee has abundant celebrations throughout the year honoring the city's diverse heritage, including Summerfest — the world's largest outdoor music festival
- More than 10 miles of lakefront, 1,500 restaurants and 15,000 acres of parks



“During graduate school, I participated in a microwave engineering seminar, during which I was mentored by experienced engineering professors and industry leaders and mentored junior graduate students. This helped me identify key strengths and development opportunities for myself.”

**Dr. Jennifer Black, Eng '01, Grad '03, '09**  
Radio frequency engineer and team lead  
GE Healthcare  
Waukesha, Wis.

## YOUR INVESTMENT

Furthering your education is an investment you can count on. Financial aid — in several forms — can help meet the costs of your graduate education at Marquette.

### Tuition\*

#### For full-time students:

Nine credits per semester at \$905 per credit = \$8,145 per semester

#### For part-time students:

Three to six credits per semester at \$905 per credit = \$2,715 to \$5,430 per semester

A minimum of 48 credit hours plus 12 dissertation credits is required to complete the doctoral program.

A minimum of 30 credit hours is required to complete the non-thesis master's program.

A minimum of 30 credit hours plus six thesis credits is required to complete the thesis master's program.

\*Figures provided are based on average credit hours taken per semester and exclude service fees and/or continuous enrollment/continuation course fees. Per-credit cost valid until May 2011.

### Merit-based aid

Students with promising credentials have an opportunity to receive generous amounts of aid in the form of stipends, tuition scholarships, and research and teaching assistantships (typically nine annually). U.S. Department of Education GAANN and Luce Foundation fellowships also are available for qualified candidates.

### Need-based aid

Enroll as a half- or full-time student in a degree program (at least four credit hours, usually two or more classes a semester), and you may be eligible for loans distributed through the Office of Student Financial Aid. Most student loans have competitive interest rates and do not require repayment until after you complete your course of study.

To apply, file the Free Application for Federal Student Aid each year between January 1 and mid-February. It's available from the Office of Student Financial Aid or at [fafsa.ed.gov](http://fafsa.ed.gov). Once you have been admitted to your program and completed your financial aid paperwork, we will determine your eligibility and send you a notice explaining what financial aid you are eligible to receive from the university.

### Additional resources

- Marquette offers a convenient payment plan that divides tuition costs into monthly installments. For more information, visit [marquette.edu/mucentral](http://marquette.edu/mucentral) or contact Marquette Central at (414) 288-4000.
- Employment assistance is available.
- Private lenders feature special educational loans.
- Your employer may offer a tuition-remission plan.
- Some private foundations offer financial aid for graduate study.
- Tax credits can be claimed for work-related educational expenses.



Marquette engineering alumni go on to do so well in their careers. At my workplace, A.O. Smith Corp., I am surrounded by lead engineers, scientists and manager-directors who graduated from Marquette. The university and engineering companies benefit from the local synergy between academia and industry."

#### Dr. Daniel Ionel

Adjunct professor at Marquette  
Officer of A.O. Smith Corp.  
Milwaukee

## YOUR OPPORTUNITIES

Where could a graduate degree in electrical and computer engineering lead you? You'll find our recent graduates ...

#### working for a variety of companies, including:

- A.O. Smith Corp.
- Eaton Corp.
- Exxon Mobil
- GE Healthcare
- Johnson Controls Inc.
- Rockwell Automation

#### and for foundations and public laboratories, including:

- American Association for the Advancement of Science
- national laboratories in Asia, Europe and the United States
- universities throughout the United States

## YOUR FIRST STEP

### We invite you to apply.

#### Application requirement checklist:

- Online application at [marquette.edu/grad](http://marquette.edu/grad) (must be submitted before all other admission materials)
- Application fee
- Official transcripts from all current and previous colleges/universities except Marquette
- Three letters of recommendation
- (For doctoral applicants only) A brief statement of purpose
- (For doctoral applicants only) Submission of any English-language publications authored by the applicant is optional but strongly recommended; this includes any master's thesis or essay the applicant has written
- (For doctoral and international applicants) GRE scores (general test only)
  - The GRE is also recommended for, and may be required of, master's applicants with undergraduate grade point averages of less than 3.0
- (International applicants only) TOEFL score or other acceptable proof of English proficiency with a minimum score of 79-80 on the Internet-based (computer) version, not including speaking
- If necessary, submit any additional hard-copy materials in one envelope to:

Marquette University Graduate School  
P.O. Box 1881  
Milwaukee, WI 53201-1881



### We invite you to speak with a faculty member.

Dr. Michael T. Johnson  
Director of graduate studies and associate professor  
P.O. Box 1881  
Milwaukee, WI 53201-1881  
Phone: (414) 288-0631  
Fax: (414) 288-5579  
E-mail: [michael.johnson@marquette.edu](mailto:michael.johnson@marquette.edu)





**MARQUETTE**  
UNIVERSITY

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**Be The Difference.**

**Marquette University Graduate School**

Phone: (414) 288-7137 or (800) 793-6450, ext. 7

E-mail: [mugs@marquette.edu](mailto:mugs@marquette.edu)

1324 West Wisconsin Avenue | Holthusen Hall, Room 305 | P.O. Box 1881

Milwaukee, Wisconsin 53201-1881

[marquette.edu/grad](http://marquette.edu/grad)