LEHIGH UNIVERSITY | P.C. Rossin College of Engineering and Applied Science

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Industrial and Systems ENGINEERING

Graduate Degree Programs

IT'S ALL ABOUT **IMPACT**

"Everyone is talking about machine learning today and ***Lehigh's optimization program is one of the top programs in the U.S.*** *As a graduate student, I* ***spoke at conferences*** *and* ***co-authored multiple papers*** *in a highly practical area of optimization—improving algorithm design for continuous optimization. My work helped* ***build a strong resume*** *and connections with industry."*

Suyun Liu '22 PhD
Applied scientist at Amazon

Industrial and systems engineers optimize complex processes, systems, networks, investments, and organizations across nearly all sectors of society.

Lehigh University's graduate programs in the Department of Industrial and Systems Engineering (ISE) propel students into leadership roles in the engineering of leading-edge decision-making techniques using the most advanced data analytics, machine learning, and computational approaches.

Under the guidance of Lehigh ISE's world-renowned faculty, you will gain specialized technical knowledge and an interdisciplinary outlook that opens doors and overcomes obstacles.

From day one, you will join a welcoming, close-knit, and dynamic intellectual community that will elevate your trajectory and set you up to make a lasting impact—wherever your passions, curiosity, and dedication take you.

Lehigh ISE graduate programs

ON CAMPUS

- **PhD, Industrial and Systems Engineering**

ON CAMPUS AND ONLINE

- **M.Eng., Healthcare Systems Engineering**
- **M.Eng. and MS, Industrial and Systems Engineering**
- **M.Eng. and MS, Management Science and Engineering**
- **MS, Financial Engineering**
- **MS, Data Science**
- **Certificate in Data Science**
- **Certificate in Healthcare Systems Engineering**
- **Certificate in Management Science and Engineering**

IT'S ALL ABOUT **BALANCE**

Lehigh's Department of Industrial and Systems Engineering offers graduate students a vibrant, engaging setting for scholarship, advanced research, and professional growth. Faculty members go beyond "advising" to provide true, lasting academic mentoring. Through scholarly rigor and an entrepreneurial, collaborative mindset, we challenge and encourage our students to evolve into tomorrow's leaders in our field.

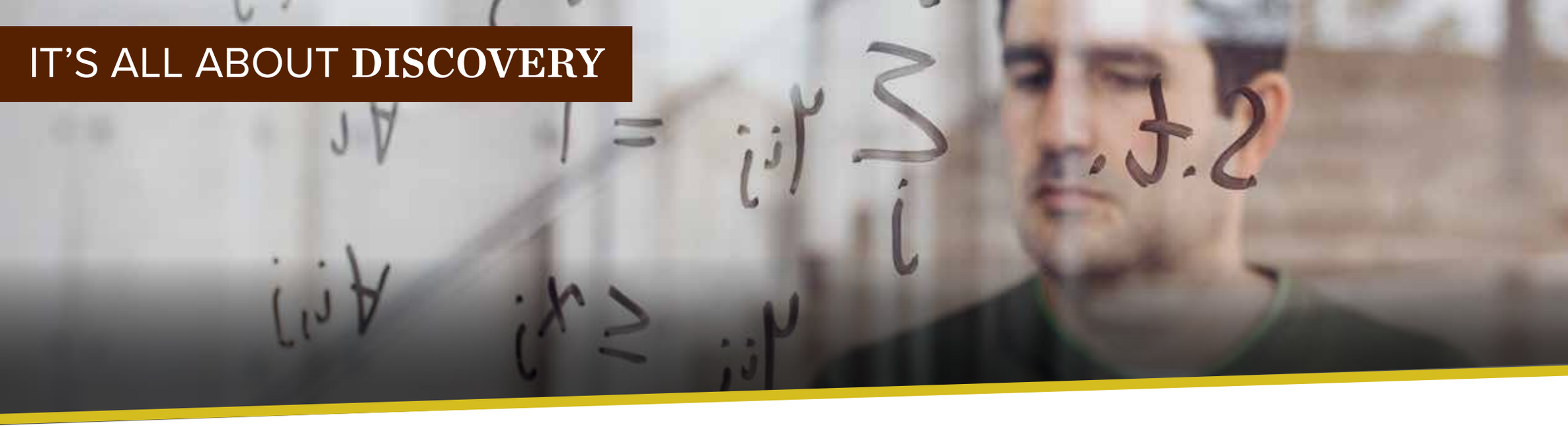
As educators, we value personal interaction and maintain a favorable student-to-faculty ratio, while providing access to significant research resources and an expansive network of internal and external partnerships that rivals those of far larger universities.

It is a balance that many institutions aspire to develop, but at Lehigh, it is in our DNA.

As a graduate student, you will learn from and work with internationally recognized faculty experts addressing issues in areas such as mathematical optimization, stochastic models and optimization, data science and machine learning, applied operations research, quantum computing optimization, and uncertainty quantification and complex systems.

Students thrive in our tight-knit community and find value in our network of successful Lehigh alumni.

IT'S ALL ABOUT **DISCOVERY**



Industrial and systems engineering research at Lehigh is supported by a wide array of public and private sponsors, including the National Science Foundation, Commonwealth of Pennsylvania, Office of Naval Research, U.S. Department of Energy, and U.S. Department of Defense.

The department's research is divided into six principal areas:

Mathematical optimization
Mathematical optimization provides a comprehensive and elegant methodology to support decision-making where goals such as cost, efficiency, profit, or risk are optimized under limited resources or other constraints. We investigate a wide spectrum of challenging optimization problems for which we also develop, analyze, and implement efficient and reliable algorithms.

Stochastic models and optimization
Lehigh researchers create next-generation methodological tools and algorithms for various decision-making problems under uncertainty, such as robust optimization models for location, routing, and scheduling. Stochastic algorithms are powerful computational tools for solving optimization problems, and they are key in training machine learning models and solving complex combinatorial decisions.

Applied operations research
Operations researchers create models and methods for the systems, mechanisms, and networks that guide modern society—think power grids and fuel networks, supply chains, production, and transportation, as well as finance, healthcare, and government services. Our teams develop novel models, algorithms, computational methodologies, and theories to design, manage, and operate these systems in ways that are efficient, effective, safe, and equitable.

Data science and machine learning
Massive amounts of digital data are collected and stored on a scale once considered unimaginable. Our researchers develop state-of-the-art algorithms for solving modern data-science problems that are key to progress in fields such as artificial intelligence.

Quantum computing optimization
Quantum computing harnesses the properties of subatomic particles to perform computations in a fundamentally different way than classical computing. Lehigh teams develop quantum optimization algorithms to solve extremely difficult combinatorial optimization problems—questions for which classical high-performance computing cannot provide answers.

Uncertainty quantification and complex systems
We investigate complex, large-scale engineering systems that face uncertainty. Lehigh research spans areas such as queuing systems, experimental design, sensitivity analysis, control under uncertainty, statistical inverse problems, and multi-fidelity methods, among others.

Lehigh's Interdisciplinary Research Institutes (IRIs) enable the university to solidify and further develop its strengths in key focus areas that resonate among our community of faculty, student researchers, and their external collaborators.

- **Institute for Cyber Physical Infrastructure and Energy (I-CPIE)**
- **Institute for Data, Intelligent Systems, and Computation (I-DISC)**
- **Institute for Functional Materials and Devices (I-FMD)**

For more, **visit lehigh.edu/iri**.

IT'S ALL ABOUT **LEADERSHIP**

Lehigh's world-renowned industrial and systems engineering faculty pursue game-changing research while inspiring the next generation of innovators and thinkers in our field. The ISE department places in the top 20% in all industrial engineering rankings, and more than half of Lehigh ISE faculty have received prestigious awards and/or hold international board positions. The department has a heritage of contribution to industrial progress and academic literature. Professors lead, mentor, and encourage students to tackle tough questions, while providing access to state-of-the-art research facilities and cutting-edge knowledge in a highly collaborative environment.

Ana I. Alexandrescu
Healthcare delivery operations

Pat Costa
Integrated Business and Engineering (IBE) program

Frank E. Curtis
Nonlinear optimization; machine learning

Aida Khajavirad
Nonlinear, integer, and combinatorial optimization; algorithm development

Akwum Onwunta
Uncertainty quantification; PDE-constrained optimization; scientific machine learning

Derya Pamukcu
Information systems; automation; analytics

Eugene Perevalov
Information theory

Louis J. Plebani
Computational operation research and applications

Ted Ralphs
Parallel computing; large-scale optimization

Daniel P. Robinson
Computational optimization; applications in machine learning and computer vision

Karmel S. Shehadeh
Mathematical optimization; scheduling theory and algorithms

Larry V. Snyder
Supply chain optimization; energy systems

Robert H. Storer
Heuristic optimization; healthcare systems

Tamás Terlaky
Convex and conic optimization

Gregory L. Tonkay
Manufacturing systems; tele-communications

Luis Nunes Vicente
Continuous optimization; computational science

Xiu Yang
Uncertainty quantification; scientific machine learning; data-driven methods

Emory W. Zimmers
Enterprise systems; leadership

Luis F. Zuluaga
Polynomial optimization; financial engineering

IT'S ALL ABOUT **WHAT'S NEXT**

Lehigh's solid track record for graduate placement is a hallmark of our industrial and systems engineering programs, with Lehigh ISE alumni holding influential positions in leading companies across the country and around the world. Students who complete a master's degree at Lehigh are highly competitive applicants to higher degree programs, whether they remain on campus or attend other prominent universities. Lehigh's PhD program cultivates students' academic aspirations—with strong placement in faculty careers as well as intermediate postdoctoral positions at other prestigious institutions—and opens doors to specialized roles in industry and at national laboratories.

- **Accenture**
- **Amazon**
- **Amobee**
- **Argonne National Lab**
- **Boeing**
- **Coupa Software**
- **CVS**
- **Goldman Sachs**
- **Geisinger Health System**
- **IBM Research**
- **J.P. Morgan Chase**
- **Merck**
- **Meta/Facebook**
- **PwC**
- **SAS**
- **Target**
- **Uber**
- **University of Chicago**

*"The **academic rigor** of Lehigh's ISE program prepared me to work hard, master my craft, and grow as an individual. My early success in management consulting was partly due to the **work ethic, flexibility, and resilience** that I reinforced through my graduate education. The teaching I received was extremely practical and relevant. As Lehigh engineers, we focused on what mattered—**real results that worked**. This approach has been foundational in my professional career."*

Sunil (Sunny) A. Misser
CEO, AccountAbility

IT'S ALL ABOUT YOU

Outside of our classrooms and labs, Lehigh industrial and systems engineers are a driven cohort of future scholars and professionals that are fully engaged in the university's graduate student landscape, the campus at large, and our local community.

Our active chapter of INFORMS (the leading international association for operations research and analytics professionals) hosts socials throughout the year—think picnics, potlucks, parties, and game nights. A number of our graduate students play important roles in Lehigh's Chinese, South Asian, and Iranian student associations and other international student groups.

Opportunities for professional development abound. Lehigh's Enterprise Systems Center offers a strong platform for internships and client-driven projects for our graduate students, providing connections and pathways for industrial application experience.

Lehigh ISE's PhD program offers unique and powerful training for students interested in pursuing academic careers. Our graduate students regularly travel to international conferences and workshops to present their findings, and they are routinely recognized in these settings through competitive awards and grants.

Bethlehem and Pennsylvania's Lehigh Valley

Lehigh University is located in the heart of the beautiful Lehigh Valley, the third largest metropolitan area in Pennsylvania. Home to top-notch entertainment, shopping, and restaurants, our region is also known for its seemingly endless array of opportunities for outdoor exploration and adventure.

Bethlehem is a vibrant city, rich in history and known for its small-town friendliness and feel. The arts are alive here, with exciting seasonal events, nationally recognized musical acts, comedy, art, and more. Known as the "City of Festivals," Bethlehem hosts 20-plus major festivals and over 150 mini-festivals each year.

Need more action? Plan a day or weekend trip to New York City, Philadelphia, the Pocono Mountains, or the New Jersey and Delaware beaches—all within easy reach by car or public transportation.

PhD STUDIES

Doctoral students in industrial and systems engineering work alongside internationally recognized experts and enjoy a 5-to-1 student-to-faculty ratio that ensures personalized mentoring and close collaboration. All of our PhD students receive 100% funding of tuition, and we grant approximately $40,000 annually in book and travel scholarships to support students in presenting their work at top technical meetings and professional conferences.

Year 1

You will engage in core courses to build your foundation, partner with your advisor to tailor your program and electives to meet your goals, establish technical skills critical to your career success, and identify and join a research group.

Year 2

You will continue to focus on coursework and will achieve your first programmatic research milestone: the PhD qualifying exam. Your summer may involve research or an internship.

Year 3

Your focus will shift more toward research and you will achieve your second programmatic research milestone: the formal creation of a doctoral committee. Again, your summer is likely to revolve around research or an internship.

Year 4

As your research momentum builds, you will continue your pursuit of technical research goals. If you are interested in an academic career, you'll gain experience teaching and mentoring.

Year 5

As you explore future post-doctoral opportunities, you will achieve your third programmatic research milestone: your formal dissertation defense.

The Department of Industrial and Systems Engineering provides a supportive environment that enables doctoral students to flourish. Over the course of your studies, you will develop the knowledge, skills, and perspective necessary for true research leadership—launching you into the next phase of your career.

- **Average time to complete degree: 4.8 years**
- **Placement post-degree: 93%**
- **Average starting salary: $98,000**

MASTER'S STUDIES

Lehigh's master's degrees in industrial and systems engineering are rigorous, yet designed with flexibility. While many students complete a 12-month, three-term sequence as outlined below, others choose a four-term sequence (beginning Fall semester) to enable course-free summer research or internship opportunities. Still others design a course path that is suited to their desired pace. Master's students in industrial and systems engineering come from a variety of backgrounds, including related disciplines such as engineering, science, mathematics, economics, health, and finance.

Summer

During this semester, core coursework will help you establish advanced foundational knowledge in industrial and systems engineering.

Fall

This semester is all about customizing your degree with electives that will guide you in the direction of your research and career goals. MS students also will explore research opportunities.

Spring

Your master's degree culminates in this semester with coursework that caps off a custom-tailored advanced degree. Your advisor and research network will support you as you pursue the next chapter in your professional development and career.

Graduates consistently acknowledge the critical role a Lehigh master's degree plays in their successful advancement along technical and management career paths.

- **Degree completion in as little as one year, or at your own pace**
- **Placement post-degree: 98%**
- **Average starting salary: $76,000**

Many master's and certificate programs in industrial and systems engineering can be completed either on campus or online, in one year, or at your own pace:

- **M.Eng., Healthcare Systems Engineering**
- **M.Eng. and MS, Industrial and Systems Engineering**
- **M.Eng. and MS, Management Science and Engineering**
- **MS, Financial Engineering**
- **MS, Data Science**
- **Certificates in Data Science, Healthcare Systems Engineering, and Management Science and Engineering**

ADMISSIONS INFO

Application deadlines

Fall semester admission: December 15 (PhD) or July 15 (master's)

Spring semester admission: December 1 (master's)

All applications undergo a rigorous, holistic review. Decisions are based on multiple factors extending beyond simple benchmarks, including motivation for advanced study, tenacious pursuit of personal and technical goals, strong or strengthening academic record, and the desire and skill set to tackle challenging questions—whether in industrial practice, the academic research lab, or even the university classroom/lab—recognizing the continuum of prior opportunities available to our applicants.

Apply today!
Scan code or visit
engineering.lehigh.edu

Application guidelines

Prior degrees: Applicants must have earned a Bachelor of Science (BS) or a Master of Science (MS) in industrial and systems engineering or a related engineering discipline by the time of their matriculation. Applicants with degrees in related science and technology fields are also welcome. Bridging coursework is available as needed to help ensure a smooth transition from less conventional technical degrees into our programs.

GRE not required: Neither unofficial nor official GRE scores are required. If submitted, scores will not be used in evaluating an application.

GPA benchmark: GPA *(US equivalent)* of at least 2.75 (4.0 scale) or a graduate GPA of at least 3.0 (4.0 scale) on a minimum of 12 hours of graduate work is preferred. GPA standards for international institutions will be followed accordingly. Consideration will be given to a trend showing a strengthening of core GPA during final semesters of study.

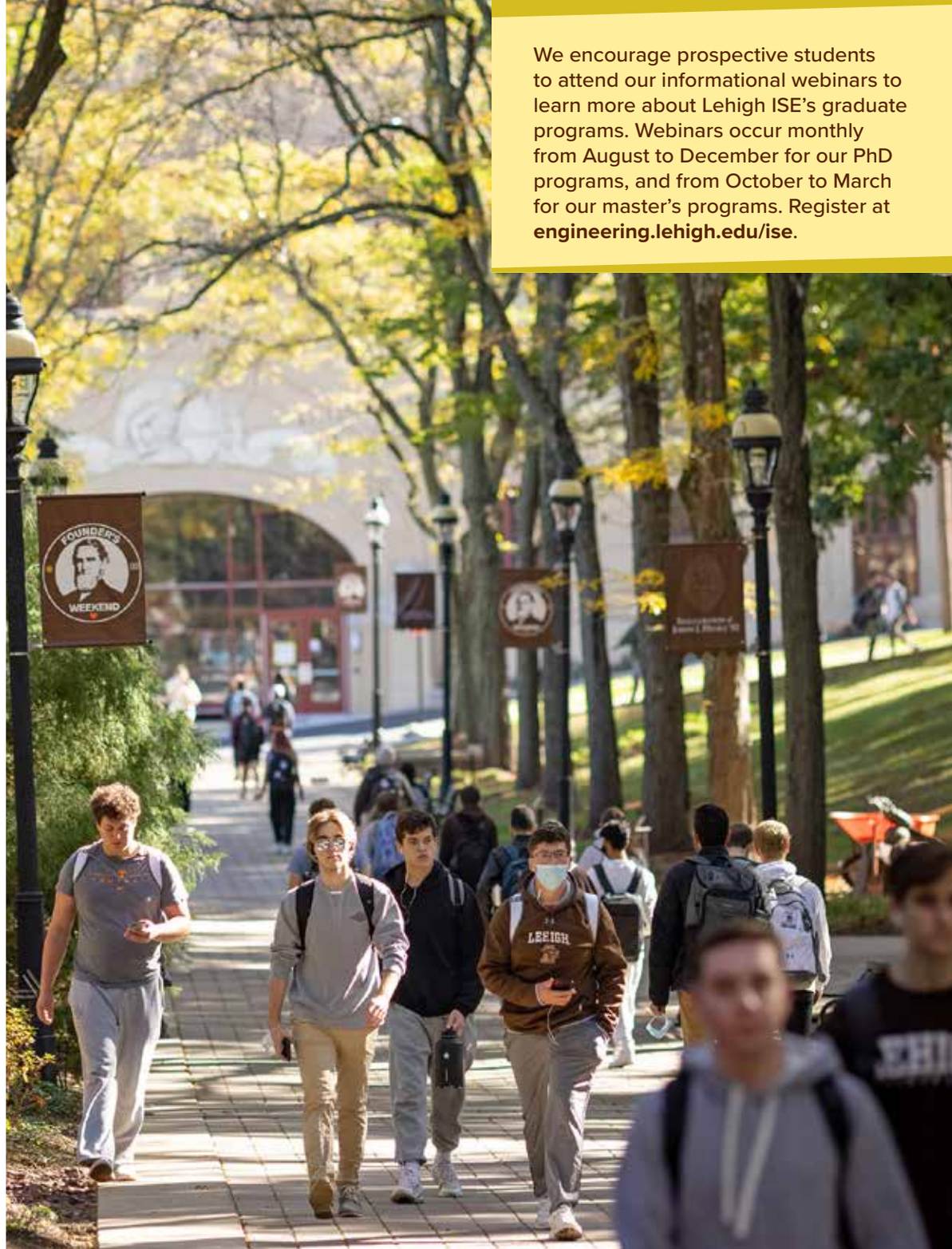
TOEFL or IELTS (international students only): Official TOEFL or IELTS scores sent to Lehigh University by ETS (Educational Testing Service). If the applicant received a degree in the United States within the past two years, these test scores can be waived. Both assessments are valid for only two years from the date the test was taken. *Individual "skill section score" recommendations for Lehigh University and the Internet-based TOEFL are:* Writing (20), Speaking (20), Reading (20), Listening (15), Composite score (79). *Individual "skill section score" recommendations for Lehigh University and the IELTS are:* Writing (6.0), Speaking (6.5), Reading (6.5), Listening (6.0), Overall score (6.5).

Complete applications also must include:

- **Candidate's resume** summarizing background relevant to graduate study, including (but not limited to) education/degrees (with GPA), class rank, relevant coursework, projects, research, scientific publications, relevant work experience, career goals, and extracurricular activities. The resume should be current, documenting experiences (in reverse chronological order) and all positions held up to and at the time of application.
- **Candidate's personal statement** detailing motivation for graduate study, relevant background, and, if applicable (i.e., PhD and MS applicants), research experience, specific research interests, and specific faculty of interest.
- **Complete transcripts** from each college and university attended. Unofficial copies may be uploaded by the candidate, but official transcripts from the prior institution's Registrar's Office must be submitted by candidates who accept offers of admission.
- **Letters of recommendation** – Two (2) letters of recommendation submitted online directly by qualified individuals who are able to evaluate the applicant's academic achievements and potential for graduate studies and, if applicable, research. Preference is given to letters from research advisors and professors, but relevant letters from technical/industrial employers who are able to speak to a candidate's potential for graduate study and research will also be accepted.
- **Application fee** of $75 (non-refundable)

Applicants who do not meet the above-mentioned requirements may be admitted at the department's discretion.

We encourage prospective students to attend our informational webinars to learn more about Lehigh ISE's graduate programs. Webinars occur monthly from August to December for our PhD programs, and from October to March for our master's programs. Register at **engineering.lehigh.edu/ise**.



engineering.lehigh.edu/ise

To learn more, please contact:

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