

# Chemical & Biomolecular Engineering

Graduate Degree Programs



LEHIGH  
UNIVERSITY

*Lehigh University's Department of Chemical and Biomolecular Engineering* offers students a vibrant and engaging academic setting at a scale that balances distinguishably personalized education and mentorship with excellence and impact in advanced research and professional growth.

Established in 1903, Chemical and Biomolecular Engineering is one of the oldest degree programs at Lehigh University and one of the oldest Chemical Engineering programs in the US.

Over our 115+ year history, Lehigh chemical engineers have embraced an entrepreneurial culture, helping to establish a heritage of academic and scientific leadership and collaboration.

Students have opportunities to work with internationally recognized faculty experts on cutting-edge research problems spanning energy and the environment, biomolecular sciences, functional materials and nanotechnology, colloidal and interfacial science, molecular modeling and simulations, and data science, systems, and controls. All flavors of research are possible, including experiments, modeling, simulation, and theory, and combinations thereof.

*We offer numerous graduate degree programs, including:*

Ph.D. in Chemical Engineering

M.S. in Chemical Engineering

M.E. in Chemical Engineering

(on campus and distance)

M.E. in Biological Chemical Engineering

(on campus and distance)

M.E. in Chemical Energy Engineering

(on campus and distance)



# Department & Faculty

The strong reputation of our faculty is underscored by numerous prestigious national faculty research awards including several AIChE Institute Awards, various National Academy Memberships and Institute Fellowships in addition to 5 recent NSF-CAREER awards and 1 DOE CAREER award.

*Lehigh's ChBE department is ranked 22nd overall*

in the most recent (2010) decennial National Research Council's report on graduate programs and has a history of sustained impact since ranking 5th nationally among High-Impact Chemical Engineering Departments based on publication and citation measures.

(Source: Thomson ISI, 1996-2000 ranking)

The breadth and strengths of our department research span Biomolecular Sciences, Energy & the Environment, Functional Materials & Nanotechnology, Colloidal & Interfacial Science, Molecular Modeling & Simulations, and Data Science, Systems & Controls.

Our research is funded by the National Science Foundation (NSF), Office of Naval Research (ONR), National Institutes of Health (NIH), Department of Energy (DOE), Petroleum Research Fund (PRF), Commonwealth of Pennsylvania, and NASA, as well as various industrial partners



## 16

Total Tenure-Track Faculty

## II

Full Professors

## 4

Associate Professors

## I

Assistant Professor

## I

Professors of Practice

## 3

Adjunct Faculty

## 2

Jointly Appointed Faculty

## 7

Emeritus Faculty

# Master's Programs in Chemical Engineering *at a glance*

Our Master's programs embrace an interactive culture for advanced education and professional growth. This includes opportunities for research side-by-side doctoral students on problems at the cutting edge of current Grand Challenges, and a variety of stimulating technical and career development seminar series and symposia.

## M.S. in Chemical Engineering

(On campus only)

The Master of Science in Chemical Engineering is a degree program that integrates rigorous advanced coursework with cutting-edge research. Graduates have a technical breadth and depth that offers versatility in tackling fundamental to applied problems in the chemical engineering and related industries as well as the pursuit of further advanced degrees.

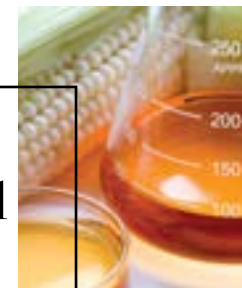
## M.E. in Chemical Engineering

(On campus & Distance Learning)

The Master of Engineering in Chemical Engineering is comprised of rigorous advanced engineering coursework in core chemical engineering principles and a breadth of related topics. Students are given flexibility for tailoring their advanced elective coursework to customize their degree and match their career goals.

## Specialized Master's Programs

### M.E. in Biological Chemical Engineering



(On campus & Distance Learning)

The Master of Engineering in Biological Chemical Engineering degree program involves an integrated mixture of core chemical engineering and biotechnology graduate coursework with flexibility to choose among biology, chemistry, and chemical engineering electives customized for careers in biomolecular and biopharmaceutical engineering.

### M.E. in Chemical Energy Engineering

(On campus & Distance Learning)

The Master of Engineering in Chemical Energy Engineering is comprised of advanced coursework for professionally-oriented graduates that offers in-depth technical understanding and a global perspective of chemical energy engineering practice.

“Lehigh’s supportive faculty and close-knit department helped me develop the skills and independence I needed for graduate study. I’m grateful for the incredible academic opportunities I’ve had because of our ChBE program.”

Sam Layding, LU MS '20  
Pursuing Ph.D. at the University of Pennsylvania

# Year 1



**Full Fall & Spring Semesters**  
**Advanced core ChBE coursework**  
 Establishing advanced foundational knowledge in chemical engineering

M.S. & M.E.

**November, December, & January**  
**Exploring breadth of M.S. research opportunities**  
 Detailed exploration of research opportunities culminating in identification of faculty lab for hosting M.S. research

M.S. Specific

**Beginning of Spring Semester**  
**Embarking on M.S. research**  
 Joining a research group and taking first steps toward establishing a research identity while building a fundamental foundational background that motivates, frames, and enables early research advances

M.S. Specific



M.S. Specific

**Summer**  
**Productive and focused M.S. research**  
 Seizing course-free opportunity to accelerate research progress

M.S. & M.E.

**Full Spring Semester**  
**Tailoring degree to meet career objectives**  
 Customizing degree with choice of elective graduate coursework relevant to research (M.S.) and career goals  
**Establishing skills critical for success along the technical career ladder**  
 Departmental seminar series for first-year graduate students aimed at building technical skills important for reaching career goals

# Year 2



**Full Fall Semester**  
**Pursuing next career steps**  
 Establishing career goals and pursuing opportunities to help meet them after completion of your degree

M.S. & M.E.

**Full Spring Semester**  
**Growing customized technical background through advanced elective coursework**  
 Culminating coursework to establish a custom-tailored advanced degree enabling pursuit and achievement of career goals in the chemical engineering and related industries

M.S. & M.E.

## All Years & All Semesters

Program-long activities

Developing broad science & engineering context, cultivating curiosity, establishing critical connections

Departmental seminar series from leading academics and industrial experts on topics spanning science, engineering & technology



# On-Campus Master's Degree Timeline

# Ph.D. Program *at a glance*

Lehigh's doctoral program offers a distinguishably interactive culture for advanced study, research & professional growth.

We value our students and recognize them with numerous annual graduate student awards and fellowships over the full course of the program: highlighting exceptional promise of first-year students and research productivity, impact, and academic performance for students up through graduation.

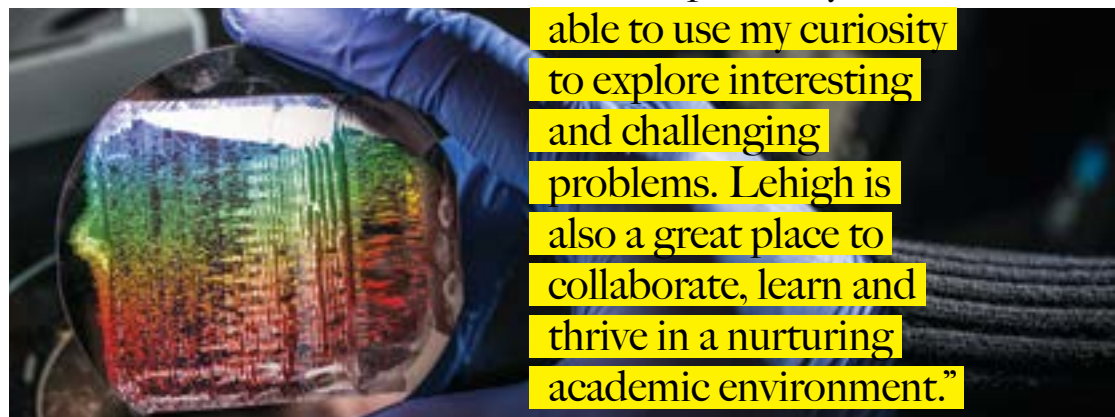
A variety of stimulating technical and career development seminar series and an annual departmental research symposia offer venues for continuous scientific and professional growth.

Lehigh Ph.D. students additionally have many opportunities to present research in local, national and international conferences and workshops. Our students are routinely recognized for their research in these settings through competitive national and international awards and travel grants



“The PhD program at Lehigh built upon my experience and took it to the next level. I gained the necessary tools to do world class research and most importantly, I was able to use my curiosity to explore interesting and challenging problems. Lehigh is also a great place to collaborate, learn and thrive in a nurturing academic environment.”

Gorgi Pavlov, LU Ph.D. '19  
Scientist, Formulation Development  
Group, Regeneron



**\$29k** annual guaranteed minimum stipend

**45%** female students

**\$0** tuition cost with health benefits

**87%** Ph.D. completion rate

strong job placement in **INDUSTRY & ACADEMIA**

**4.7 years** average duration of Ph.D.

**\$39k** Lehigh merit awards annually to ChBE Ph.D. students

# All Years & All Semesters

Program-long activities

Developing broad science & engineering context, cultivating curiosity, establishing critical connections

Departmental seminar series from leading academics and industrial experts on topics spanning science, engineering & technology



## Year 1

### Full Fall Semester

#### Advanced core ChBE coursework

Establishing advanced foundational knowledge of classical and statistical thermodynamics, reaction engineering, and engineering mathematics

### September – Mid-October

#### Exploring breadth of research opportunities

Detailed exploration of funded research opportunities via faculty research overviews and meetings, culminating in student rankings and narratives on top projects

### Beginning of November

#### Embarking on Ph.D. research

Joining a research group and taking first steps toward establishing a research identity and receiving research advisor assignments

### Full Spring Semester

#### Advanced core ChBE and elective coursework

Reinforcing and expanding fundamental to practical knowledge of advanced topics in transport phenomena while exploring research-relevant elective coursework

#### Establishing skills critical for research success

Departmental seminar series for first-year graduate students aimed at building technical skills to support progress in and effective technical communication of research

### Spring Semester Through Summer

#### Building and sustaining research momentum

Full integration into a research group while building a fundamental foundational background that motivates, frames, and enables early research advances

### Summer

#### Productive, focused research

Seizing course-free opportunity to accelerate research progress while growing understanding of relevant literature and fundamental scientific techniques

## Year 2

### First Week of Fall Semester

#### Ph.D. qualifying exam – First programmatic research milestone

Demonstrating potential for success in Ph.D. study through written documentation and oral defense of early research progress, fundamental understanding, and critical analysis

### All of Year 2

#### Advancing fundamental technical background

Completion of elective coursework to establish tools, skills, and insight enabling research progress and impact

#### Sustained research momentum and progress

Continued pursuit of technical research goals and milestones with an eye on scientific publication and conference presentations

## Year 3

#### Ph.D. proposal defense – Second programmatic research milestone

Formal establishment of doctoral committee, with written and oral exposition and defense of research progress and proposed technical pathway for completing dissertation

## Year 4

#### Sustained research momentum and progress

Continued pursuit of technical research goals and milestones with an eye on scientific publication and conference presentations

## Year 5

#### Culmination of Ph.D. research

Achieving final research objectives and completing body of scientific contributions, impactful scientific publications, and thesis

#### Pursuing next career steps

Establishing career goals and pursuing opportunities to help meet them after completion of your degree

#### Showcasing and defending body of Ph.D. research – Third programmatic research milestone

Formal public Ph.D. Dissertation Defense before Ph.D. committee, leading to doctorate in Chemical Engineering



# Ph.D. Timeline

# Breadth of *Vibrant* Research Opportunities

## Biomolecular Science and Engineering

### Faculty

Angela Brown  
James Hsu  
Anand Jagota  
Mayuresh Kothare  
Jeetain Mittal  
Kelly Schultz

Biomaterials  
Computational Neuroscience  
Biologically Inspired Therapeutics  
Antibiotic Alternatives  
Protein Structure, Molecular Recognition and Biological Function  
Theoretical and Computational Biophysics  
Cell Scaffolding, Tissue Engineering

## Energy and the Environment

### Faculty

Jonas Baltrusaitis  
Hugo Caram  
James Gilchrist  
Steve McIntosh  
Srinivas Rangarajan  
Elsa Reichmanis  
Mark Snyder  
Kemal Tuzla  
Israel Wachs

CO<sub>2</sub> Capture  
Environmental Catalysis  
Fuel Cells  
Membrane Separations  
Sustainability @ Food-Energy-Water Nexus  
Natural Gas, Biomass Catalytic Upgrading  
Solar Cells, Photochemistry, Photovoltaics  
Organic Semiconductors  
Computational Catalysis  
Particle Technologies

## Functional Materials and Nanotechnology

### Faculty

Jonas Baltrusaitis  
Manoj Chaudhury  
James Gilchrist  
Steve McIntosh  
Elsa Reichmanis  
Mark Snyder

Hierarchical Nanoporous Materials  
Organic, Inorganic, Hybrid Thin Films  
Solid State Electrochemistry  
Novel Catalyst Design and Characterization  
Conjugated Polymer Design, Synthesis  
Modified Surfaces: Adhesion, Friction, Wetting, Biocompatibility  
Field-Driven Colloidal Assemblies  
Quantum Dots

## Colloids and Interfacial Science

### Faculty

Angela Brown  
Manoj Chaudhury  
Anand Jagota  
Jeetain Mittal  
Kelly Schultz  
Israel Wachs

Bio-Nano-Interfaces  
Drop Fluidics  
Molecular Simulation  
Fracture and Tribology of Polymeric Interfaces  
Molecular Spectroscopy & Catalysis  
Biological Interfaces in Disease  
Pattern Formation

## Molecular Modeling and Simulation

### Faculty

Anand Jagota  
Jeetain Mittal  
Srinivas Rangarajan

Phase Behavior of Intrinsically Disordered Proteins  
Computational Catalysis  
Multi-scale Catalytic Simulations  
Coarse-Grained Modeling of Molecular Systems  
DNA-Mediated Particle Assembly, Nanotube Sorting  
Modeling Cellular Processes and Packing

## Data Science, Systems, and Controls

### Faculty

Mayuresh Kothare  
William Luyben  
Srinivas Rangarajan

Computational Systems Engineering  
Advanced Process Control, Automation  
Data Analytics  
Complex Reaction Networks  
Lean Chemical and Biopharmaceutical Manufacturing  
Non-linear Optimization



## Lehigh's strong track record for graduate placement is a hallmark of our program.

### *Examples of recent placements in industry include...*

GE, Air Products, ExxonMobil, Bayer, BASF, Rive, Honeywell UOP, Corning, Advanced Cooling Technologies, Air Products, Praxair, Air Liquide, Intel, Blue Origin, AkzoNobel, Bemis, Cummins, AMCS, Regeneron, Saint-Gobain, DuPont, Wanhua Chemical Group, Novavak, LG Haisys Ltd., Saudi ARAMCO, Benjamin Moore, Evonik

*Students who complete a Master's degree at Lehigh are highly competitive applicants to higher degree programs, with many of our Master's students pursuing Ph.D.s at various domestic programs including Lehigh's ChBE Ph.D. Program*

*Lehigh's Ph.D. program also cultivates academic aspirations of our students and has developed a proportionally impressive record of placements in faculty careers as well as intermediate postdoctoral positions at other prestigious institutions including*

- Graduates with domestic faculty positions: U. of Alberta, Cornell, Akron, Clarkson, UMass-Lowell, UT-Dallas, U. Rhode Island
- Graduates with international faculty positions: Kuwait, Taiwan, Netherlands, Turkey, India, Saudi Arabia, Korea
- Postdoctoral appointments: MIT, Harvard, Cambridge, Cornell, UT-Austin, Princeton, Rice, Cornell
- Graduates with research staff positions: Princeton (PRISM)
- National Laboratory appointments and fellowships: NIST, DOE



"...working in a group with few members gave me adequate time to discuss the research problems and learn directly from my adviser. The five years spent at Lehigh were the crucial formative years in my academic career...I grew both as a person and an academic in this environment, and am thankful for the opportunities I received during my time in Lehigh."

**Aditi Chakraborty, LU Ph.D. '17**  
Postdoctoral Fellow, Harvard John A. Paulson School of Engineering and Applied Sciences

"I thoroughly enjoyed and appreciated my journey at Lehigh University. Faculty members and staff were always helpful and supportive. At Lehigh, I had many resources to conduct high quality research, and most importantly, my advisor was extremely patient and supportive of my learning and growth. Moreover, I had the opportunity to guide and lead high school and undergraduate research projects and present my research work at various conferences all of which were very helpful in expanding my professional network and enhancing my communication skills."

**Maryam Daviran, LU Ph.D. '20**  
LU M.S. '19

# Admissions

## *Application Requirements*

### 1. **Prior degrees**

Applicants must have earned a **Bachelor's of Science** (B.S.) or a **Master of Science** (M.S.) in Chemical Engineering or a related engineering discipline by the time of their matriculation. Applicants with degrees in related science fields (e.g., chemistry, physics), while less common, will also be considered.

### 2. **GRE not required**

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

### 3. **GPA benchmark**

GPA (US equivalent) higher than 3.3 on a 4.0 scale is preferred. In order to be considered for admission, an applicant must have an undergraduate cumulative GPA of 3.0 or higher and a GPA of 3.0 or higher for the last two semesters of undergraduate studies. GPA standards for international institutions will be followed accordingly.

*Consideration will be given to a trend showing a strengthening of the core GPA during the final semesters of study.*

### 4. **TOEFL or IELTS**

(international students only):

*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 (6.0).

Explore all that the P.C. Rossin College of Engineering and Applied Science (<https://engineering.lehigh.edu/>) at Lehigh University has to offer, and apply through the Graduate Application link: <https://engineering.lehigh.edu/apply>

## *Lehigh ChBe Ph.D. Applicant Profile*

# 3.5

Average B.S. GPA

# 3.78

Average M.S. GPA

### **Backgrounds:**

ChE and  
non-conventional  
science/engineering  
(Chemistry, Physics,  
Polymer Science,  
Material Science, etc.)

# 52%

Applicants with  
Domestic B.S. or M.S.

## *Application Deadline*

# Jan. 15

For prospective graduate students seeking fall admission, full applications (including test scores and letters of recommendation) should be **submitted by no later than Jan. 15**.

Early applications are encouraged, with application review and rolling admission beginning as early as **Dec. 15**. Spring admission is also possible, albeit less common. Applications for spring admission are preferred by **August 15**, but will be reviewed on a rolling basis.

## *Complete applications will require:*

**Candidate's Resume** summarizing background relevant to graduate study, including (but not limited to) education/degrees, class rank, relevant coursework, projects, research, scientific publications, relevant work experience, career goals, extracurricular activities, etc. The resume should be current, documenting experiences 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., Ph.D. and M.S. 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.

**Testing (International Students)** 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.

**Letters of Recommendation** – At least three (3) letters of recommendation for Ph.D. applicants and two (2) letters of recommendation for M.S. applicants 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), payable to "Lehigh University"

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



# ChBE Graduate Admissions

B323 Iacocca Hall  
III Research Drive  
Bethlehem, PA 18015

 @lehighche  
 @lehighche

Visit *[engineering.lehigh.edu/chbe](http://engineering.lehigh.edu/chbe)*

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## Contact

Applicants for on-campus graduate degree programs are encouraged to contact our department directly at [inchegs@lehigh.edu](mailto:inchegs@lehigh.edu) regarding questions about aspects of any of our on campus graduate degree programs.

Questions regarding our Distance Education Master's degree programs should be directed to [inchbede@lehigh.edu](mailto:inchbede@lehigh.edu).