

# DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

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142 A.W. Smith Building (7217)

Phone: 216.368.4182

Harihara Baskaran, Leonard Case Jr. Professor and Chair  
chemengchair@case.edu

**More Information:** <http://engineering.case.edu/eche/>

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The Department of Chemical and Biomolecular Engineering offers Bachelor of Science in Engineering, Master of Science, and Doctor of Philosophy degree programs. The department has eleven full-time faculty members, all of whom lead active research programs in advanced and emerging areas of chemical and biomolecular engineering.

## Mission

The Department of Chemical and Biomolecular Engineering inspires learning and the pursuit of scholarly activities in chemical and biological engineering and related science and engineering disciplines. The Department offers educational programs and a research environment that enable our graduates to succeed in an evolving workplace, provides opportunities for students and faculty to advance knowledge at the highest levels of the profession, and addresses technological and personnel needs of industry, governments, and society.

## Background

The profession of chemical engineering involves the analysis, design, operation, and control of processes that convert matter and energy to more useful forms, encompassing processes at all scales from the molecular to the megascale. Traditionally, chemical engineers are responsible for the production of basic chemicals, plastics, and fibers. However, today's chemical engineers are also involved in food and fertilizer production, synthesis of semiconductor electronic materials, power generation and storage, CO<sub>2</sub> capture and waste recycling. Chemical engineers also develop new materials (ceramic composites and electronic chips, for example) as well as biochemicals and pharmaceuticals. The breadth of training in engineering and the sciences gives chemical engineers a particularly wide spectrum of career opportunities. Chemical engineers work in the chemical, energy, and materials-related industries, in government, and are accepted by graduate schools in engineering, chemistry, medicine, and law.

## Research

Research in the department is sponsored by a variety of state and federal agencies, by private industry, and by foundations. Current active research topics include:

### Energy

- Novel energy storage systems for transportation, grid storage applications, and portable devices
- Energy efficient extraction and processing of materials
- Fuel cells and batteries
- Novel catalysts, electrocatalysts, and plasmas for conversion of gases to fuels
- Simulation, modeling, and fundamental characterization of transport

and interfacial processes in electrochemical energy storage and conversion systems

### Materials

- Advanced materials for electronic and electrochemical device applications
- Simulation and theory of materials properties
- Surface properties and interfacial phenomena
- Materials processing and engineering at molecular through macro scales
- Advanced separation processes for the nuclear fuel cycle
- Synthesis of novel membranes for gas separations, wastewater treatment and radioanalytical chemistry
- Imaging and prediction of complex fluid dynamics
- Computational materials chemistry for energy conversion and storage

### Biomolecular Engineering

- Biosensors
- Cell and tissue engineering
- Transport and metabolism in biological systems
- Biocatalysis and protein engineering

## Chair

Harihara Baskaran, PhD

(Pennsylvania State University)

*Leonard Case Jr. Professor of Engineering*

Transport phenomena in biology and medicine, tissue/cell metabolism, cell transport, microvascular tissue engineering, cartilage tissue engineering

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## Faculty

Rohan N. Akolkar, PhD

(Case Western Reserve University)

*F. Alex Nason Professor*

Electrochemical phenomena in next-generation batteries, photovoltaics and semiconductor devices

Harihara Baskaran, PhD

(Pennsylvania State University)

*Leonard Case Jr. Professor of Engineering and Department Chair*

Transport phenomena in biology and medicine, tissue/cell metabolism, cell transport, microvascular tissue engineering, cartilage tissue engineering

Christine Duval, PhD

(Clemson University)

*Associate Professor*

Membranes, radiochemical separations

Donald L. Feke, PhD

(Princeton University)

*Distinguished University Professor and Senior Vice Provost for Academic and Faculty Affairs*

Colloidal and transport phenomena, dispersive mixing, particle science and processing

Burcu Gurkan, PhD  
(University of Notre Dame)  
*Kent H. Smith Professor for the Case School of Engineering II*  
Energy storage, nonflammable electrolytes, electrode fabrication,  
electrochemical separation processes

Eric Kaler, PhD  
(University of Minnesota)  
*Professor and University President*

Daniel Lacks, PhD  
(Harvard University)  
*C. Benson Branch Professor of Chemical Engineering and Vice Provost for  
Interdisciplinary and International Initiatives*  
Molecular simulation, statistical mechanics, triboelectric charging

Heidi B. Martin, PhD  
(Case Western Reserve University)  
*Associate Professor*  
Conductive diamond films; electrochemical sensors; chemical  
modification of surfaces for electrochemical and biomedical applications;  
biomaterials; microfabrication of sensors and devices

Julie Renner, PhD  
(Purdue University)  
*Associate Professor, Hiltner-Wilfong Designated Professor in Engineering*  
Electrochemical engineering, protein engineering, biomimetic materials,  
regenerative medicine

Robert F. Savinell, PhD  
(University of Pittsburgh)  
*Distinguished University Professor and George S. Dively Professor*  
Electrochemical engineering, electrochemical reactor design and  
simulation, electrode processes, batteries and fuel cells

Jesse S. Wainright, PhD  
(Case Western Reserve University)  
*Research Professor*  
Electrochemical power sources: fuel cells, batteries, supercapacitors;  
biomedical applications

Robert Warburton, PhD  
(Purdue University)  
*Assistant Professor*  
Computational materials science, electrochemistry, energy storage,  
catalysis

Christopher Wirth, PhD  
(Carnegie Mellon University)  
*Associate Professor*  
Colloids, multiphase materials

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## Secondary Faculty

Frank Ernst, Dr. ret. nat. habil  
(University of Gottingen)  
*Leonard Case Jr. Professor of Engineering*

Ica Manas-Zloczower, DSc  
(Israel Institute of Technology)  
*Professor*

James A. Van Orman, PhD  
(Massachusetts Institute of Technology)  
*Professor*

Huichun (Judy) Zhang, PhD  
(Georgia Institute of Technology)  
*Professor*

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## Emeritus Faculty

John C. Angus, PhD  
(University of Michigan)  
*Emeritus Professor*

Coleman Brosilow, PhD  
(Polytechnic Institute New York)  
*Emeritus Professor*

Nelson Gardner, PhD  
*Emeritus Associate Professor*

Uziel Landau, PhD  
(University of California, Berkeley)  
*Emeritus Professor*

Chung-Chiun Liu, PhD  
(Case Institute of Technology)  
*Emeritus Professor*

J. Adin Mann Jr., PhD  
(Iowa State University)  
*Emeritus Professor*

Syed Qutubuddin, PhD  
(Carnegie Mellon University)  
*Emeritus Professor*

## Programs

- Biomolecular Engineering, Minor
- Chemical Engineering, BSE
- Chemical Engineering, Minor
- Chemical Engineering, MS
- Chemical Engineering, PhD
- Electrochemical Engineering, Minor

## Dual Degrees

- Programs Toward Graduate or Professional Degrees

## Facilities

The department is housed in the Albert W. Smith Building and portions of the Bingham Building on the Case Quadrangle. Professor Smith was chair of industrial chemistry at Case from 1911 to 1927. Under his leadership, a separate course of study in chemical engineering was introduced at Case in 1913. Professor Smith was also a close associate of Herbert Dow, the Case alumnus who founded Dow Chemical in 1890 with the help and support of Professor Smith. The Albert W. Smith Chemical Engineering Building contains one technology-enhanced classroom; the undergraduate Unit Operations Laboratory; an undergraduate reading room, named after Prof. Robert V. Edwards; and the normal complement of offices and research laboratories. The lobby of the A.W. Smith Building,

renovated by contributions from the James family, often serves as a formal and informal gathering place for students and faculty. The department has exceptionally strong facilities for electrochemical and energy research, microfabrication, biomolecular engineering, and for chemical vapor deposition and thin film synthesis. In addition, departmental core facilities include a full range of biochemical and electrochemical analytical and materials characterization instruments. The Chemical Engineering Instrumentation Core | Case School of Engineering offers easy access to analytical instruments on the CWRU main campus. As a collaborative resource within the Department of Chemical and Biomolecular Engineering, its primary goal is to support research projects both at CWRU and beyond that necessitate chemical analysis. While several instruments are dedicated to spectroscopy-based techniques, the facility is equipped with various other methods, including thermal gravimetric analysis and imaging tools.