Department of Chemical and Biomedical Engineering

Degrees Offered

- Masters of Science, Biomedical Engineering (M.S.Bm.E.)
- Masters of Science, Chemical Engineering (M.S.Ch.E.)
- Masters of Science, Engineering (M.S.E.)
- Doctor of Philosophy, Chemical Engineering (Ph.D.)

The Department of Chemical and Biomedical Engineering, with fourteen active tenure-track faculty members, approximately 300 undergraduates, and nearly fifty graduate students, has one of the oldest doctoral-granting programs in the university. From the initial doctoral degree in 1932, the graduate course program has been based on advanced chemical engineering fundamentals, while the research program has reflected a balance of fundamental research areas and their application to relevant technological areas such as biomedical, bioengineering, catalysis, coal conversion, energy, fuels, materials, polymer processing, systems control, and dynamic simulation.

Areas of Research

The Chemical and Biomedical Engineering faculty are presently involved in a broad spectrum of research areas which include biomedical and biochemical engineering, systems biology, cancer, bionanotechnology, biomaterials, stem cell technology, dynamic simulation, control systems, molecular dynamics, polymers and biopolymers, catalysis, energy, hydrates, fuels, fuel cells, low-dimensional and high-temperature electronic materials, and reaction engineering. These research activities impact economic development, national security, the stability and sustainability of the energy supply, and many quality-of-life issues.

Faculty members possess a wide variety of industrial experience and are routinely in contact with their counterparts in industry. This contact with real engineering problems enables them to convey a practical experience to students while keeping in perspective many of the fundamental concepts involved in graduate study. The faculty is nationally and internationally recognized through the publication of text books, monograph series, and technical papers. They routinely participate in national and international conferences and advisory meetings. In addition, faculty members have taught short courses throughout the United States and abroad.

FACULTY

CHAIR
- Richard Turton - Ph.D. (Oregon State University)
  Bolton Professor, P.E.; Process systems engineering, Particle and powder technology, Chemical process design

PROFESSORS
- Brian J. Anderson - Ph.D. (Massachusetts Institute of Technology)
  Director, Energy Institute; GE Materials Professor. Natural gas hydrates, Sustainable energy development, Molecular dynamics, Quantum chemical calculations
- Debansu Bhattacharyya - Ph.D. (Clarkson University)
  Integrated gasification combined cycle (IGCC), Chemical looping, Fuel cells (SOFC & PEM), Optimization, Dynamic modeling of process systems, Process control
- Eugene V. Cilento - Ph.D. (University of Cincinnati)
  Dean, Physiological Transport Phenomena, Biomedical Engineering, Image Analysis, Mathematical Modeling
- Pradeep Fulay - Ph.D. (University of Arizona)
  Associate Dean for Research, Advanced Electronics, Magnetic Materials and Devices, Flexible Electronics, Synthesis and Processing of Nanomaterials
- Rakesh Gupta - Ph.D. (University of Delaware)
  Berry Professor. Polymer processing, Rheology, Non-Newtonian fluid mechanics, Composite materials
- John (Jianli) Hu - Ph.D. (Tsinghua University)
  Statler Energy Chair. Shale Gas Utilization, Catalysis in Refining Processes, Coal and Biomass Conversion
- John W. Zondlo - Ph.D. (Carnegie Mellon University)
  Coal Enhancement and Utilization, Carbon Science, Fuel Cells
ASSOCIATE PROFESSOR

- Zoica Cerasela Dinu - Ph.D. (Max Planck Inst of Molecular Cell Biology & Genetics & Dresden University of Technology)
  Associate Chair, BMEG. Nanomaterials, Bionanotechnology, Biomimetics
- David J. Klinke - Ph.D. (Northwestern University)
  Systems Biology, Kinetics, Cellular Signal Transduction Pathways, Immunology, Mathematical Modeling, Bioengineering
- Charter D. Stinespring - Ph.D. (West Virginia University)
  Semiconductor Growth and Etching, Surface Kinetics, Thin Films, Electronic Materials

ASSISTANT PROFESSOR

- Jessica L. Allen - Ph.D. (University of Texas at Austin)
  Neuromuscular biomechanics; Aging, injury, and disease-related mobility impairments; Rehabilitation engineering; Musculoskeletal modeling and simulation
- Margaret F. Bennewitz - Ph.D. (Yale University)
  Biomedical imaging, Fluorescence intravital lung microscopy, MRI contrast agents, Micro/nano drug delivery systems, Microfluidics, Tumor microenvironment, Cancer metastasis, Stem Cells
- Ahmed E. Ismail - Ph.D. (Massachusetts Institute of Technology)
  Biomass and biopolymers, Interfacial phenomena, Multi-scale modeling, Algorithm development
- Fernando V. Lima - Ph.D. (Tufts University)
- Hanjing Tian - Ph.D. (Lehigh University)
  Chemical looping combustion, CO2 capture, Shale gas utilization, Biomass gasification and refinery
- Shuo Wang - Ph.D. (California Institute of Technology)
  Human intracranial electrophysiology, Cognitive and social neuroscience

TEACHING ASSISTANT PROFESSOR

- Robin S. Hissam - Ph.D. (University of Delaware)
  Biomaterials, Polypeptides, Drug delivery, Bioengineering and materials science

LECTURER

- Jeremy S. Hardinger - Ph.D. (West Virginia University)

RESEARCH ASSISTANT PROFESSOR

- Nasagree Garapati - Ph.D. (West Virginia University)
  Carbon dioxide capture and storage (CCS) in various geologic media, utilizing carbon dioxide in gas hydrate reservoirs, petroleum reservoirs and geothermal reservoirs for enhanced gas, oil and heat recovery

RESEARCH ASSOCIATE

- Sushant Agarwal - Ph.D. (West Virginia University)
  Polymer Processing, Rheology, Nano-composites, Dispersions

ADJUNCT PROFESSORS

- Deepak Doraiswamy - Ph.D. (University of Delaware)
- Laura F. Gibson - Ph.D. (West Virginia University)
  Professor and Senior Associate VP for Research and Graduate Education; Genetics and Developmental Biology
- Joseph D. Henry - Ph.D. (University of Michigan)
  Energy Management, Science and Technology Policy
- Charles M. Jaffe - Ph.D. (University of Colorado)
  Theoretical Chemistry, Molecular and Atomic Physics, Nonlinear Dynamics, Astrodynamics, Forensics
- George E. Keller, II - Ph.D. (Pennsylvania State University)
  Separations, Commercial Practice
- Mahesh Padmanabhan - Ph.D. (University of Minnesota)
  Foods, Polymer Science, Rheology
- Yon Rojanasakul - Ph.D. (University of Wisconsin, Madison)
  Pharmaceutical Sciences
- George A. Spirou - Ph.D. (University of Florida, Gainesville)
  Neuroscience
Robert H. Wildi - B.Ch.E. (Cleveland State University)
Polymer Extrusion

Stephen Zitney - Ph.D. (University of Illinois at Urbana-Champaign)
Dynamics, Control and optimizationof energy systems; Computational fluid dynamics (CFD) and Process Co-simulation; Pulverized coal combustion; Integrated gasification combined cycle (IGCC); Chemical looping; Supercritical CO2 power cycles; CO2 capture

Yuxin Liu - Ph.D. (Louisiana Tech University)
Microelectronics

Sam M. Mukdadi - Ph.D. (University of Colorado, Boulder)
Mechanical Engineering

Thirimachos Bourlai - Ph.D. (University of Surrey, U.K.)
Electrical and Electronic Engineering

Scott M. Galster - Ph.D. (The Catholic University of America)
Applied Experimental Psychology

Valeriya Gritseniko - Ph.D. (University of Alberta)
Neuroscience

Joshua A. Hagen - Ph.D. (University of Cincinnati)
Materials Science and Engineering

Victor S. Finomore, Jr. - Ph.D. (University of Cincinnati)
Applied Experimental Psychology (Human Factors)

Jeffrey S. Reynolds - Ph.D. (West Virginia University)
Electrical Engineering

John Twist - Ph.D. (Rutgers University)
Pharmaceutical Sciences

Sergiy Yakovenko - Ph.D. (University of Alberta)
Neuroscience

Eung H. Cho - Ph.D. (University of Utah)
Mineral Processing, Leaching, Solvent Extraction, Environmental Science

Dady B. Dadyburjor - Ph.D. (Delaware)
Catalysis, Reaction Engineering

Edwin L. Kugler - Ph.D. (Johns Hopkins)
Catalysis, Adsorption, Coal Liquefaction

Joseph A. Shaeiwitz - Ph.D. (Carnegie-Mellon University)
Design, Design Education, Outcomes Assessment

Alfred H. Stiller - Ph.D. (University of Cincinnati)
Physical/Inorganic/Solution Chemistry, Coal Liquefaction, Carbon Science

Ray Y.K. Yang - Ph.D. (Princeton)
Biomedical and Chemical Engineering, Nonlinear Dynamics

For specific information on the following programs, please see the links to the right:

- Biomedical Engineering
- Chemical Engineering

COURSES

**CHE 531. Mathematical Methods in Chemical Engineering. 3 Hours.**
PR: MATH 261 and consent. Classification and solution of mathematical problems important in chemical engineering. Treatment and interpretation of engineering data. Analytical methods for ordinary and partial differential equations, including orthogonal functions and integral transforms. Vector calculus. (3 hr. lec.).

**CHE 565. Corrosion Engineering. 3 Hours.**
PR:CHE 320 or CHEM 341 or equivalent. Basic mechanisms of various types of corrosion such as galvanic corrosion, pitting corrosion and stress corrosion cracking; methods of corrosion prevention such as cathodic and anodic prevention, by using coatings and inhibitors, and by selecting proper alloys. (3 hr. lec.).
CHE 566. Electronic Materials Processing. 3 Hours.
PR: Graduate standing in Engineering, Physics, Chemistry, or instructor consent. Design and application of thermal, plasma, and ion assisted processing methodologies; design and function of key process tools and components; vacuum technology; solid state, gas phase, surface, and plasma chemistry underpinnings; thin film nucleation, growth, and etching; effects of processing methods and conditions on materials properties.

CHE 580. Advanced Cellular Machinery. 3 Hours.
PR: Consent. Coverage and application of principles of cellular biology to enable the integration of cell components into biotechnological applications.

CHE 591. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

CHE 593. Special Topics. 1-6 Hours.
PR: Consent. A study of contemporary topics selected from recent developments in the field.

CHE 610. Fluidization Engineering. 3 Hours.
PR: Consent. Fundamentals of fluidization, two-phase flow theory and powder characteristics, structure and property of the emulsion phase and bubbles, mass and heat-transfer in fluidized beds with and without chemical reaction. (3 hr. lec.).

CHE 611. Powder Technology. 3 Hours.
PR: Consent. Characterization of powders, structure of powders, powders in two-phase flow, measurement techniques, static and dynamic behavior of powders, grinding and agglomeration, chemistry of powders. (3 hr. lec.).

CHE 615. Transport Phenomena. 3 Hours.
PR: Consent. Introduction to equations of change (heat, mass, and momentum transfer) with a differential-balance approach. Use in Newtonian flow, turbulent flow, mass and energy transfer, radiation, convection. Estimation of transport coefficients. (3 hr. lec.).

CHE 620. Thermodynamics. 3 Hours.
PR: Consent. Logical development of thermodynamic principles. These are applied to selected topics including development and application of the phase rule, physical and chemical equilibria in complex systems, and nonideal solutions. Introduction to nonequilibrium thermodynamics. (3 hr. lec.).

CHE 625. Chemical Reaction Engineering. 3 Hours.
PR: Consent. Homogeneous and heterogeneous reaction systems, batch and flow ideal reactors, macro- and micro-mixing, non-ideal reactors, diffusion and reaction in porous catalysts, reactor stability analysis, special topics. (3 hr. lec.).

CHE 687. Materials Engineering. 3 Hours.
A study of materials engineering fundamentals emphasizing semiconductor, polymer, metal, and ceramic/cementitious material systems. Mechanical and physical properties, theoretical aspects, testing, design criteria, manufacturing, and economics of material systems. Laboratory testing and evaluation. (Equivalent to CE 687, EE 687, MINE 687, IMSE 687 and MAE 687.) (3 hr. lec.).

CHE 693. Special Topics. 0-6 Hours.
A study of contemporary topics selected from recent developments in the field.

CHE 694. Seminar. 1-6 Hours.
Seminars on current research by visitors and graduate students.

CHE 697. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

CHE 716. Advanced Fluid Dynamics. 3 Hours.
PR: Consent. Analysis of flow of fluids and transport of momentum and mechanical energy. Differential equations of fluid flow; potential flow, laminar boundary-layer theory, and non-Newtonian fluids. (3 hr. lec.).

CHE 717. Advanced Heat Transfer. 3 Hours.
PR: Consent. Theory of transport of thermal energy in solids and fluids as well as radiative transfer. Steady state and transient conduction; heat transfer to flowing fluids; evaporation; boiling and condensation; packed- and fluid-bed heat transfer. (3 hr. lec.).

CHE 718. Advanced Mass Transfer. 3 Hours.
PR: Consent. Theory of diffusion, interphase mass-transfer theory, turbulent transport, simultaneous mass and heat transfer, mass transfer with chemical reaction, high mass-transfer rates, and multicomponent macroscopic balances. (3 hr. lec.).

CHE 720. Applied Statistical and Molecular Thermodynamics. 3 Hours.
PR: CHE 620 and consent. The connection between macroscopic phenomena (thermodynamics) and microscopic phenomena (statistical and quantum mechanics). Thermodynamics modeling for process analysis. Equations of state, perturbation theories, mixing rules, computer simulation, group-contribution models, and physical-property prediction. (3 hr. lec.).

CHE 726. Catalysis. 3 Hours.
PR: CHE 625 or consent. Physical and chemical properties of catalytic solids, nature and theories of absorption, thermodynamics of catalysis, theories of mass and energy transport, theoretical and experimental reaction rates, reactor design, and optimization. (3 hr. lec.).

CHE 730. Advanced Numerical Methods. 3 Hours.
CHE 731. Optimization of Chemical Engineering Systems. 3 Hours.
PR: Consent. Optimization in engineering design, unconstrained optimization and differential calculus, equality constraints optimization, search technique, maximum principles, geometric and dynamic programming, linear and nonlinear programming, and calculus of variations. (3 hr. lec.).

CHE 761. Polymer Rheology. 3 Hours.
Qualitative behavior of polymeric liquids; Rheometry; stress, strain and rate of strain tensors; equations of motion; Hookean solids and Newtonian liquids, linear viscoelasticity; constitutive equations for solutions and melts. (3 hr. lec.).

CHE 790. Teaching Practicum. 1-3 Hours.
PR: Consent. Supervised practice in college teaching of chemical engineering. Note: This course is intended to insure that graduate assistants are adequately prepared and supervised when they are given college teaching responsibilities. It will also present a mechanism for students not on assistantships to gain teaching experience. (Grading may be S/U.).

CHE 791. Advanced Topics. 1-6 Hours.
PR: Consent. Investigation of advanced topics not covered in regularly scheduled courses.

CHE 792. Directed Study. 1-6 Hours.
Directed study, reading, and/or research.

CHE 793. Special Topics. 1-6 Hours.
A study of contemporary topics selected from recent developments in the field.

CHE 794. Seminar. 1-6 Hours.
Special seminars arranged for advanced graduate students.

CHE 795. Independent Study. 1-9 Hours.
Faculty supervised study of topics not available through regular course offerings.

CHE 796. Graduate Seminar. 1 Hour.
PR: Consent. Each graduate student will present at least one seminar to the assembled faculty and graduate student body of his or her program.

CHE 797. Research. 1-15 Hours.
PR: Consent. Research activities leading to thesis, problem report, research paper or equivalent scholarly project, or a dissertation. (Grading may be S/U.).

CHE 798. Thesis or Dissertation. 1-6 Hours.
PR: Consent. This is an optional course for programs that wish to provide formal supervision during the writing of student reports (698), or dissertations (798). Grading is normal.

CHE 799. Graduate Colloquium. 1-6 Hours.
PR: Consent. For graduate students not seeking coursework credit but who wish to meet residency requirements, use the University’s facilities, and participate in its academic and cultural programs. Note: Graduate students who are not actively involved in coursework or research are entitled, through enrollment in their department’s 699/799 Graduate Colloquium to consult with graduate faculty, participate in both formal and informal academic activities sponsored by their program, and retain all of the rights and privileges of duly enrolled students. Grading is S/U; colloquium credit may not be counted against credit requirements for masters programs. Registration for one credit of 699/799 graduate colloquium satisfies the University requirements of registration in the semester in which graduation occurs.