The mission of the Department is to provide the highest quality programs to educate students in the principles and applications of Chemical and Biomolecular Engineering. The excellence of the program is ensured by the high regard for teaching, strong research activities and solid industrial ties. The program educates students to take leadership roles in industry, academia and government.

The Graduate Program
The Department of Chemical and Biomolecular Engineering at Tulane is one of the oldest chemical engineering departments in the country. Graduate programs are available at the M.S. and Ph.D. levels, though the emphasis is on doctoral education. One of six departments in the School of Engineering, the department has nine full-time faculty, whom are active in teaching and research. The department has been expanding steadily over the past several years, with significant increases in both the number of graduate students and the amount of funded research. Currently, there are approximately 35 full-time graduate students, most of whom are pursuing a Ph.D. degree.

The chemical engineering graduate student body is a diverse mixture of both American and foreign students. Approximately 25% of the students are female. The department promotes a comfortable environment for research, where one-on one interactions between faculty and students are highly encouraged. A popular forum for presenting results is the graduate student seminar program. Every two weeks during the fall and spring semesters, graduate students give an informal presentation of their work to both faculty and students. Participation is strictly voluntary and the format encourages open discussion and exchange of ideas.

Doctor of Philosophy Degree
The Ph.D. degree requires a student to reach a critical understanding of the basic scientific and engineering principles underlying their field of interest. In addition, the student must demonstrate the ability to conduct independently an intensive research project and document their results in the form of refereed publications, presentations, and a final thesis dissertation. Specifically, candidates for the Ph.D. degree must

- complete a minimum of 48 credit hours of approved course work; (For students already possessing a M.S. or equivalent degree in chemical engineering, the requirement can be reduced to 24 credit hours.)
- pass a qualifying examination;
- present an acceptable dissertation prospectus to a dissertation committee;
- make an original contribution to the field of chemical engineering in the form of a dissertation suitable for publication; and
- defend the dissertation during a public presentation.

The Ph.D. degree requires 48 hours of approved graduate course plus a thesis. These courses must include three core graduate chemical engineering courses: 1) Advanced Reactor Design; 2) either Transport Phenomena I or Transport Phenomena II; and 3) either Thermodynamics and Properties of Matter, or Applied Statistical Mechanics. Ph.D. candidates are also allowed 15 independent study credits toward the 48 credit requirement. Ph.D. candidates who transfer M.S. credits will be allowed 9 independent study credits toward the 48 credit requirement. A maximum of 24 graduate credits may be transferred toward the Ph.D.

Frequently, students without an undergraduate chemical engineering degree will enroll in the graduate program. To ensure that all students are familiar with the fundamental principles required of chemical engineers, students entering the graduate program with a bachelor's degree in an area other than chemical engineering may be
required to take undergraduate courses recommended by the Graduate Committee. These undergraduate courses do not count toward the total graduate-level credit requirement for the advanced degree. Graduate students may take these courses out of sequence and/or concurrently in order to expedite completion of this requirement.

Completing the Ph.D. requirements normally requires four to five years of full-time study beyond the B.S. degree. Students already possessing an M.S. degree in chemical engineering typically require one year less time. Students who complete their degree requirements receive a Doctor of Philosophy (Ph.D.) degree.

**Master of Science Degree**

The M.S. degree emphasizes the enhancement of knowledge in the field of chemical engineering, above what is gained in the undergraduate curriculum.

The Chemical and Biomolecular Engineering Department offers both a thesis and non-thesis option for obtaining a master’s degree. Graduate students on financial aid can earn a M.S. degree only with the approval of Department and after writing a thesis that is approved by the student’s thesis committee.

For students completing a thesis, 24 hours of approved graduate course work are required. The full-time M.S. normally requires two years of full-time graduate study beyond the B.S. degree. With the approval of the department, part-time students may also select a non-thesis option which requires 30 credits of approved graduate course work. These courses must include three core graduate chemical engineering courses: 1) Advanced Reactor Design; 2) either Transport Phenomena I or Transport Phenomena II; and 3) either Applied Thermodynamics or Applied Statistical Mechanics. Master's candidates are also allowed 6 independent study credits toward the 24/30 credit requirement.

Frequently, students without an undergraduate chemical engineering degree will enroll in the graduate program. To ensure that all students are familiar with the fundamental principles required of chemical engineers, students entering the graduate program with a bachelor's degree in an area other than chemical engineering may be required to take undergraduate courses recommended by the Graduate Committee. These undergraduate courses do not count toward the total graduate-level credit requirement for the advanced degree. Graduate students may take these courses out of sequence and/or concurrently in order to expedite completion of this requirement.

**Molecular and Cellular Biology Program**

The Department of Chemical and Biomolecular Engineering and the Interdisciplinary Graduate Program in Molecular and Cellular Biology at Tulane established in 1993 a combined degree program that culminates in a Ph.D. and provides graduate students with a strong theoretical and research background in both engineering and the biological sciences. This unique education is designed to prepare future bioengineers and biotechnologists to work in a discipline that is becoming increasingly interdisciplinary. It is at the interface between engineering and biological sciences where many of the breakthroughs in these two fields occur.

The graduate MCB program involves a total of 80 faculty from Tulane University's School of Medicine, School of Engineering, School of Liberal Arts and Sciences, School of Public Health and Tropical Medicine, the Health and Environmental Research Center, and the Tulane Regional Primate Research Center. Faculty and students pursue research in a wide variety of topics, including cell- membrane phenomena, DNA replication and recombination, molecular and developmental neurobiology, protein design and engineering, gene therapy, and environmental pathobiology.

During the first two years, students are required to take specific core courses in engineering, molecular biology and cell biology and attend a seminar series in which faculty and students present their particular research. In addition, students are introduced to research during the first year of graduate training by a program of rotations through faculty laboratories. At the end of the first year, it is expected that each student will select a research supervisor and will have initiated their dissertation research.

For further information on this program, please refer to the MCB Link on Professor O'Connor's Home Page. (http://www.tulane.edu/~kim/oconnor.html). The following article includes a description on the Combined Degree Program:

To apply to the Combined Degree Program, please send a request for application materials to Professor Kim O'Connor.

Prof. Kim O'Connor
Department of Chemical and Biomolecular Engineering
Tulane University
Lindy Boggs Center Room 300
New Orleans, LA 70118
Phone: (504) 865-5740
E-mail: koc@tulane.edu

**Graduate Courses**

Graduate courses are those numbered in the 600s and 700s; 600-level courses may be taken by advanced undergraduates. The numbers in parentheses next to the course title indicate the course credit. The contact hours, or the actual number of weekly hours of lecture, laboratory, and other class work, are indicated after the credit.

- **CENG 600 Chemical Engineering Research Seminar (0) Lecture 1.** Students are exposed to the important research findings, presented by invited speakers as well as by professors and advanced Ph.D. candidates of our own department.
- **CENG 601 Mathematical Methods for Engineers (3) Lecture 3.** Prerequisite: MATH 224. Review of calculus and ordinary differential equations, series solutions and special functions, complex variables, partial differential equations, and integral transforms.
- **CENG 611 Thermodynamics and Properties of Matter (3) Lecture 3.** Prerequisite: CHEM 311. Molecular thermodynamics of multi-component systems are reviewed with particular attention to separation processes. Thermal and chemical equilibrium properties are examined for pure and mixed fluids.
- **CENG 612 Graduate Transport Phenomena (3) Lecture 3.** Prerequisites: 232, 333, 334, and MATH 221, MATH 224 or equivalents. Mathematical formulation and solution of problems involving theoretical concepts in fluid mechanics, heat and mass transfer, thermodynamics and elementary reaction theory. Emphasis is placed upon transient transport processes and the associated partial differential equations.
- **CENG 613 Surface and Colloid Phenomena (3) Lecture 3.** A study of surface and colloid chemistry. Topics include characterization of particles and surfaces, stability of colloidal systems, interactions of charged particles, and electrokinetic phenomena.
- **CENG 616 Heterogeneous Catalysis (3) Lecture 3.** A study of the fundamental concepts underlying catalytic processes in the petroleum processing industry and in synthetic fuels research. Topics include molecular theories of adsorption and catalysis, catalyst design and formulation, instrumental methods of catalyst characterization, transport in catalysts, shape-selective catalysis, etc. Applications discussed include catalytic cracking, reforming, hydrodesulfurization, Fischer-Tropsch synthesis, direct and indirect coal liquefaction, etc.
- **CENG 625 Applied Numerical Analysis (3) Lecture 3.** Prerequisite: CENG 323 or equivalent, MATH 224. Numerical techniques for the solution of mathematical problems in the engineering analysis of systems are presented for computer implementation. Topics include interpolation, integration, solution of systems of linear and nonlinear algebraic equations, optimization, and regression. A comparison of numerical solution methods for ordinary and partial differential equations is given. Eigenvalue and split boundary problems are included.
CENG 633 Advanced Separations Design (3) Lecture 3.
Prerequisites: CENG 232, 333, 334 or approval of instructor. Design of separations processes based upon newer technologies. Special emphasis is placed upon membrane separations and those processes involving colloidal and surface phenomena.

CENG 640 Introduction to Gene Therapy (3) Lecture 3.
A survey into the fundamental aspects of gene delivery and their application to gene therapy. Topics include various gene carriers, carrier/DNA interaction and complex formation, complex interactions with cells and cell structures, targeting, gene therapy applications, host response. A knowledge of cell and molecular biology is not required.

CENG 642 Advanced Materials Design (3) Lecture 3.
Prerequisites: consent of instructor. Fundamentals of condensed matter are elaborated upon, namely bonding, structure, physical properties, phase equilibria and thermodynamics of solids. Characterization of condensed phases as it reviewed. Manipulation of material properties for specific applications is discussed.

CENG 645 Applied Biochemistry I (3) Lecture 3.
Prerequisite: CHEM 241/243. Biochemistry is the study of the chemistry and chemical processes involved with the molecules that are utilized by living organisms. This two-semester series will provide an in-depth coverage of carbon- and nitrogen-containing molecules such as proteins and DNA and certain cofactors. In the first semester enzyme kinetics and catalysis will be covered, along with carbohydrates and their metabolism. The metabolic pathways and associated bioenergetics of glycolysis and the TCA cycle will be examined in detail. The material will be related to everyday life, diet, nutrition, and exercise performance.

CENG 646 Applied Biochemistry II (3) Lecture 3.
Prerequisite: CENG 645. This course is a continuation of CENG 645 (please refer to the related course description). Principles taught in CENG 645 will be extended as they are applied to lipids and nitrogen-containing molecules, and the metabolism of each. Example molecules include fats, triglycerides, DNA, amino acids, heme, and urea. The interplay of biochemistry and molecular biology will also be examined.

CENG 655 Sol-Gel Science (3) Lecture 3.
A study of chemistry, physics, and applications of sol gel processing. Designs and fabrications of functional and nanostructured materials. Recent advances of sol-gel science in nanotechnology, microelectronics, and biomedical engineering.

CENG 671 Biochemical Engineering (3) Lecture 3.
Prerequisite CENG 250 or equivalent. An advanced course in biochemical engineering. Topics include enzyme catalyzed and cell-associated reactions, engineering aspects of recombinant DNA technology, cell culture, bioreactors and tissue engineering.

CENG 677 Advances in Biotechnology (3) Lecture 3.
The objectives of the course are to enhance understanding of the basic principles of biotechnology and to introduce the most current biotechnology research. Topics include gene therapy, microbial pesticides, genetically engineered food, stem-cell technology and tissue engineering.

CENG 686 Readings and Research (2-4).

CENG 689 Polymer Engineering and Science (3) Lecture 3.
Fundamentals of polymer science and engineering, including synthesis, characterization, properties and processing of polymeric materials. An overview of polymer structure, including classification, tacticity, conformation and configuration will be given. Synthetic techniques will be reviewed, including addition and condensation polymerization and copolymerization. Polymer thermodynamics will be described, including an introduction to Flory-Huggins theory, as well as polymer-polymer miscibility and blends. A brief overview of characterization will be given, including molecular weight and glass transition temperature determination. Properties will be discussed, including mechanical properties of semi-crystalline polymers and elastomers. The time-temperature superposition principle will be described, as well as a brief introduction to processing techniques.
CENG 712 Thermodynamics of Macromolecules (3) Lecture 3.
Prerequisite: 611 or equivalent. Thermodynamics is applied to macromolecules. Fundamentals of the thermodynamics of polymers in solution and in the melt. Topics of polymer self-assembly, polymer-surfactant interactions, and polymer nanocomposites are incorporated in the course. Students will learn methods of characterization of polymer thermodynamics using spectroscopy, microscopy and scattering techniques.

CENG 715 Advanced Reactor Design (3) Lecture 3.
Coupled reaction and transport phenomena as they are involved in major reactor configurations are studied with attention to data resources and computational capabilities.

CENG 752 Applied Statistical Mechanics (3) Lecture 3.
The course covers the fundamental principles and methods of statistical mechanics. Emphasis is placed on applications to thermodynamics, phase behavior, polymer science and self-assembly phenomena.

CENG 781, 782 Advanced Independent Research (3,3).
Research studies performed under faculty tutelage by prior arrangement.

CENG 788 Polymer Rheology (3) Lecture 3.
Non-Newtonian phenomena, material functions and generalized Newtonian fluids, rheometry, linear viscoelasticity, multiphase systems and mixing.

CENG 789 Adv Macromolecular Chemistry and Materials (3) Lecture 3.
This course will cover various topics on the design, synthesis and applications of polymers and nanocomposites. The goals of this course is to teach the students basic polymer science, in particular, polymer synthesis and characterization, and to expose the students to the current-state-of-art polymer research. The representative topics include basic polymer synthesis and characterization, supramolecular assembly, functional polymers, polymeric nanocomposites, biopolymers, and polymeric devices.

CENG 791-794 Master’s Level Research Orientation and Methods (1,1,1,1)

CENG 891, 892 Doctoral Level Research Seminar (1,1)

CENG 998 Master’s Research

CENG 999 Dissertation Research
FACULTY ROSTER

PROFESSORS


Vijay T. John, Department Chair, Engr. Sc.D., Columbia University, 1982; Chemical Engineering. Nanotechnology, Biotechnology.


ASSISTANT PROFESSORS


PROFESSOR OF PRACTICE


PROFESSOR EMERITUS


ADJUNCT PROFESSOR