COLUMBIA | ENGINEERING
The Fu Foundation School of Engineering and Applied Science

CHEMICAL ENGINEERING

The graduate program in chemical engineering, with its large proportion of elective courses and independent research, offers experience in any of the fields of departmental activity mentioned in previous sections. For both chemical engineers and those with undergraduate educations in other related fields such as physics, chemistry, and biochemistry, the Ph.D. program provides the opportunity to become expert in research fields central to modern technology and science.

M.S. Degree in Chemical Engineering

The requirements are (1) the core courses: Mathematical methods in chemical engineering (CHEN E4010)/Partial differential equations (*APMA E4200*), Transport phenomena, III (*CHEN E4110*), Advanced chemical kinetics (*CHEN E4130*), and Advanced chemical engineering thermodynamics (*CHEN E4130*)/Statistical mechanics (*CHAP E4120*); and (2) 18 points of 4000- or 6000-level courses, approved by the graduate coordinator or research adviser, of which up to 6 may be Master's research (*CHEN 9400*). Students with undergraduate preparation in physics, chemistry, biochemistry, pharmacy, and related fields may take advantage of a special program leading directly to the master's degree in chemical engineering. This program enables such students to avoid having to take all undergraduate courses in the bachelor's degree program.

CHEN E4010 Mathematical Methods in Chemical Engineering. *3 points.* Prerequisites: (CHEN E3120) and (CHEN E4230) or equivalent, or instructor's permission.

Mathematical description of chemical engineering problems and the application of selected methods for their solution. General modeling principles, including model hierarchies. Linear and nonlinear ordinary differential equations and their systems, including those with variable coefficients. Partial differential equations in Cartesian and curvilinear coordinates for the solution of chemical engineering problems.

CHEN E4020 Protection of industrial and intellectual property. *3 points.*

To expose engineers, scientists and technology managers to areas of the law they are most likely to be in contact with during their career. Principles are illustrated with various case studies together with active student participation.

CHEN E4110 MECHANISMS OF TRANSPORT PHENOMENA IN FLUIDS. *3 points.* Prerequisites: (CHEN E3120) CHEN E3110X and CHEN E3120Y or the equivalent

Continuum frame-work for modeling non-equilibrium phenomena in fluids with clear connections to the molecular/microscopic mechanisms for "conductive" transport. Continuum balances of mass and momentum; continuum-level development of conductive momentum flux (stress tensor) for simple fluids; applications of continuum framework for simple fluids (lubrication flows, creeping flows). Microscopic developments of the stress for simple and/or complex fluids; kinetic theory and/or liquid state models for transport coefficients in simple fluids; Langevin/Fokker- Plank/Smoluchowski framework for the stress in complex fluids; stress in active matter; applications for complex fluids.

CHEN E4115 Topics in Transport Phenomena. *3 points.*

Prerequisites: Undergraduate fluid mechanics, or transport phenomena, or instructor's permission.

Self-contained treatments of selected topics in transport phenomena (e.g., rheology, nonequilibrium thermodynamics, molecular-level aspects of transport turbulence). Topics and instructor may change from year to year. Intended for junior/senior level undergraduates and graduate students in engineering and the physical sciences.

CHEN E4130 Advanced Chemical Engineering Thermodynamics. *3 points.* Prerequisites: Successful completion of an undergraduate chemical engineering thermodynamics course.

The course provides a rigorous and advanced foundation in chemical engineering thermodynamics suitable for chemical engineering PhD students expected to undertake diverse research projects. Topics include Intermolecular interactions, non-ideal systems, mixtures, phase equilibria and phase transitions and interfacial thermodynamics.

CHEN E4660 Biochemical Engineering. *3 points.* Prerequisites: (CHEN E4320) or CHEN E4320 or instructor's permission.

Engineering of biochemical and microbiological reaction systems. Kinetics, reactor analysis, and design of batch and continuous fermentation and enzyme processes. Recovery and separations in biochemical engineering systems.

CHEN E4760 Genomics sequencing laboratory. *3 points.*

Lect: 1. Lab: 2.**Not offered during 2019-20 academic year.** Prerequisites: Undergraduate level biology, organic chemistry and instructor's permission.

The chemical, biological and engineering principles involved in the genomics sequencing process will be illustrated throughout the course for engineering students to develop the hands-on skills in conducting genomics research.

CHEN E4900 Topics in Chemical Engineering. *3 points.*

Lect: 3.**Not offered during 2019-20 academic year.**

Prerequisites: Instructor's permission

Additional current topics in chemical engineering taught by regular or visiting faculty. Special topics arranged as the need and availability arise. Topics usually offered on a one-time basis. Since the content of this course changes each time it is offered, it may be repeated for credit.

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CHEMICAL ENGINEERING FACULTY

JINGGUANG CHEN

THAYER LINDSLEY PROFESSOR OF CHEMICAL ENGINEERING VICE CHAIR

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SAMUEL RUBEN–PETER G. VIELE PROFESSOR OF ELECTROCHEMISTRY; PROFESSOR OF CHEMICAL ENGINEERING AND OF EARTH AND ENVIRONMENTAL ENGINEERING; CHAIR OF CHEMICAL ENGINEERING

V. FAYE MCNEILL

ASSOCIATE PROFESSOR OF CHEMICAL ENGINEERING

AARON MOMENT

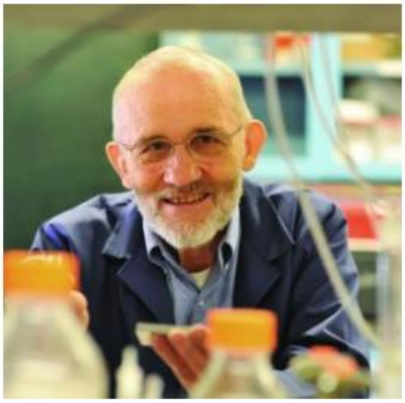
PROFESSOR OF PRACTICE IN CHEMICAL ENGINEERING

ALLIE OBERMEYER

ASSISTANT PROFESSOR OF CHEMICAL ENGINEERING

SANAT K. KUMAR

BYKHOVSKY PROFESSOR OF CHEMICAL ENGINEERING



EDWARD LEONARD

PROFESSOR OF CHEMICAL ENGINEERING; PROFESSOR OF BIOMEDICAL ENGINEERING

LAUREN MARBELLA

ASSISTANT PROFESSOR OF CHEMICAL ENGINEERING