

Chemical and Biological Engineering Ph.D.



Contact Information

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Faculty

Professor Dixon, Chair; Professors Bang, Puszynski, and Winter; Associate Professor Gilcrease; Assistant Professors Benjamin, Menkhaus, and Sani.

Program Advisory Council

Professors Bang; Dixon, and Puszynski, Program Coordinator; Associate Professor Gilcrease.

Chemical and Biological Engineering

The Department of Chemical and Biological Engineering (CBE) offers, in addition to B.S. and M.S. degrees in Chemical Engineering, a Ph.D. degree in Chemical and Biological Engineering. The Ph.D. program provides the Chemical and Biological Engineering Ph.D. graduate a core educational experience in transport phenomena, chemical kinetics, biochemical engineering, chemical thermodynamics, and biotechnology.

This knowledge base, along with key electives, provides graduate students the training to participate in biochemical and petrochemical processing, bio-based energy technologies, including biomass and biofuels; bio-based and bio-compatible materials; bioremediation; emerging energy technologies; synthesis and functionalization of nanomaterials, and processing of polymers and composite materials. These areas are aligned with the expertise of our current staff plus the additional expertise that is being added through newly hired faculty members.

The State of South Dakota is recognized as a leader and major producer of ethanol from starch in the United States. Hence the State of South Dakota is well positioned to play an important role in development of new bio-based technologies and value-added agricultural products. This Ph.D. program is integral with the recently established 2010 Center for Bioprocessing Research and Development (CBRD) at the South Dakota School of Mines and Technology and the South Dakota State University. The CBRD Center focus is to develop the fundamental understanding and technologies to convert lignocellulose to fuels and key building block chemicals. The research foci of the CBRD; pretreatment, conversion, extremophiles, separations, and process simulation and economic analysis, relies on the fundamental underpinnings taught in the Chemical and Biological Engineering Ph.D. program.

The Ph.D. program is also a strong supporter of State focused areas in advanced materials, polymers, composites, and nanotechnology. Opportunities exist for CBE Ph.D. students to participate in cutting-edge research funded by the National Science Foundation, the Department of Energy, the Department of Defense, and industrial collaborators.

The Ph.D. Program in Chemical and Biological Engineering is administered by a Graduate Program Coordinator and Program Advisory Council consisting of appointed faculty members actively involved in the program. The Program Advisory Council is responsible for the curriculum and program policies.

Curriculum

The current curriculum is designed to provide the CBE Ph.D. graduate with the depth and breadth of engineering knowledge to become a leader in their chosen focus area. To facilitate this, each student is asked to complete a program of study plan that will provide the framework for the student's course work and research. This should be filed with the Program Coordinator before the midterm of the second semester in residence. The CBE Ph.D. Advisory Council must approve all programs of study. Detailed information on examination policy, admission to candidacy, and defense of dissertation are included in the Chemical and Biological Engineering Ph.D. Program Handbook. Below is the summary of the basic required courses:

Category	Credits
Required courses ¹ (minimum 6 credits from Chemical Engineering and 6 credits from Biological Engineering focus areas)	24
Required seminar	2
Minimum required research credits	30
Minimum electives ^{1,2}	12
TOTAL	80

¹Students entering with a M.S. degree in Chemical Engineering or a closely related discipline may apply a maximum of twenty-four (24) course credit hours toward the required and elective course requirements subject to approval of the Chemical and Biological Engineering Ph.D. Program Advisory Council.

²Elective courses can be selected from other School of Mines courses as a part of a student's program of study, subject to approval of his/her major professor and graduate committee.

Students entering the program with B.S. or M.S. degrees from disciplines other than Chemical or Biochemical Engineering will be required to take several selected courses in Chemical Engineering at the undergraduate level, to provide a firm understanding of engineering principles. The Graduate Record Examination (GRE), three letters of recommendation, and a GPA of 3.00 or better are required of all

applicants for the Ph.D. program. The TOEFL exam is required for students whose native language is not English.

All CBE Ph.D. candidates are required to successfully complete the required minimum credits and earn a grade of "C" or better, except for a final grade of "S" in CBE 898.

Required courses (focus area — Chemical Engineering)

CBE 544	Reactor Design	3
OR		
CBE 728	Heterogeneous Kinetics	3
CBE 550	System Analysis Applied to Chemical Engineering	3
CBE 612	Transport Phenomena: Momentum	3
CBE 613	Transport Phenomena: Heat	3
CBE 621	Advanced Chemical Engineering Thermodynamics I	3
CBE 616	Computations in Transport Phenomena	3
CBE 714	Transport Phenomena: Mass	3

Required courses (focus area — Biological Engineering)

CBE 584	Fundamentals of Biochemical Engineering	3
CBE 584L	Biochemical Engineering Lab	3
CBE 731	Industrial Microbiology and Biotechnology	3
CBE 733	Metabolic Engineering	3
CBE 734	Intro to Biocatalysis	3
CBE 735	Bioseparations	3
CBE 792	Molecular Biology for Engineers	3

Required courses (Seminar and Research)

CBE 890	Graduate Seminar	1
CBE 898	Ph.D. Dissertation	1-9

Example elective courses

CBE 744	Environmental Biotechnology	3
CBE 746	Microbial Metabolism and Physiology	3
CBE 750	Advanced Analysis for Chemical Engineers	3
CBE 791	Independent Study	1-3
CBE 792	Topics	1-3
CBE 890	Graduate Seminar	1

CBE 894	Adv Tech Internship	1-6
CHE 574L	Experimental Polymer Technology	1
CHE 574	Polymer Technology	3
CHE 676	Adhesion and Surface Engineering in Polymer Composites	3
CHEM 560	Biochemistry	3
CHEM 582	Environmental Chemistry	3
MES 708/708L	Advanced Instrumental Analysis	3/1
MES 712	Interfacial Phenomena	3
NANO 701	Nano Materials	3
TM 631	Optimization Techniques	3
TM 720	Statistical Process Control	2



Mines Matters: School of Mines students design, build, and race vehicles such as the Formula SAE, Mini-Baja, Human-Powered Vehicle, Alternative Fuel Vehicle, Unmanned Aerial Vehicle, and others. The teams give students the chance to apply the skills they learned in the classroom while gaining leadership and teamwork skills.