CHEMICAL ENGINEERING - 2006 Curriculum
Brigham Young University

The Discipline

Chemical Engineering deals with the development and application of manufacturing processes in which chemical and physical changes of materials are involved. Chemical engineers study and develop new methods to manage energy resources as well as commercial consumer products. They design reliable, cost-effective manufacturing plants with emphasis on safety and environmental friendliness. As problem solvers, chemical engineers work on the leading edge of technology—researching and developing the ideas of today for the designs, systems, and products of tomorrow.

Areas of instruction include heat transfer, fluid dynamics, environmental and safety design, chemical reaction kinetics, thermodynamics, separation operations, materials science, process control, and plant design. In addition, chemical engineering places strong emphasis on computer skills.

The BS curriculum is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, Inc. (ABET) and the American Institute of Chemical Engineers.

Career Opportunities

The combination of knowledge about engineering, math, and chemistry obtained in the chemical engineering curriculum is a versatile preparation that opens a wide variety of opportunities to graduates. This versatility is one reason why chemical engineers have traditionally been among the highest paid professionals in the engineering and science disciplines.

Chemical engineers make a significant difference in our quality of life. Some develop clean, new energy sources to power society. Some develop and produce fertilizers and other agricultural chemicals to assist in feeding mankind. Virtually all pharmaceuticals are produced by chemical engineers to enhance the life of millions. Others study and produce biomedical devices and artificial organs. Still others are involved in development and production of new materials for use in new high-tech products. Engineers produce chemicals ranging in use from cleaning products to medicines and from man-made fibers for clothing and textiles to plastics for construction and consumer goods.

The petroleum industry has traditionally employed a large number of chemical engineers, requiring their expertise for the discovery, production, and refining of petro-chemicals including fuels, chemicals, and oils. The information age has fueled enormous expansion of the semiconductor industry in which an ever growing number of chemical engineers are employed. Many chemical engineers are employed in environmentally related positions, working on ways to improve air and water quality, to reduce acid rain and smog, and to recycle and reduce garbage. Additionally, chemical engineers are employed by universities as teachers and researchers and by government agencies to provide answers for energy, environmental, and defense concerns. Chemical engineers also train to work in the medical, business, and legal professions.

Although chemical engineering career opportunities are diverse, job functions can be categorized more easily. Chemical engineers are usually involved in research, design, development, production, technical sales, or management.

In research, they develop new ideas, new products, and new ways to produce existing products more economically and with less environmental impact. In design, they create the processes that convert raw materials into finished products with emphasis on efficiency, safety, consumer needs, and environmental protection. The development engineer improves existing processes and technology to better meet changing needs. Process engineering involves production processes and operations. Management and technical sales involve decision making with regard to consumer needs and technical capabilities. Chemical engineers are creative problem solvers. Their careers are rewarding not only from an intellectual and financial view, but also from a personal perspective. Their solutions provide a better lifestyle for mankind.

Financing of Education

Scholarships are available as well as research assistantships and teaching assistantships. Contact the department office for details.

Internships, Co-op Education

Students are encouraged to participate in at least one professional work experience in the chemical engineering field before they graduate. These can be in the form of internships which take place during the summer months, or co-ops which require students to work during one or more semesters and thus involve adjustment of the student's course schedule.

Honorary Societies and Clubs

Students are encouraged to join the student chapter of the American Institute of Chemical Engineers (AIChE) and honor societies such as Tau Beta Pi, the engineering honor society.

Faculty Research

The Department of Chemical Engineering has a highly qualified faculty with a wide range of experience in both industry and research. Many areas of research are being pursued, including: 1) clean and efficient combustion of coals and other fuels as well as rocket propellants; 2) development of power sources for micromachines and other microsystems; 3) measurement and prediction of physical, chemical, thermodynamic, and transport properties of liquids, gases, and solids; 4) molecular simulations; 5) chemical processes and materials in biological systems, including the human body; 6) catalysis with emphasis on forming and reforming hydrocarbon fuels; 7) computer control of chemical processes; 8) mathematical modeling of chemical processes and phenomena; and 9) environmental engineering.

Undergraduate Admittance Requirements

The Chemical Engineering Department offers a professional program leading to the bachelor of science degree. The first two years of this program are considered to be pre-professional and permit unrestricted enrollment for any student who qualifies for admission to the university. The remaining two years are considered to constitute the professional program. All students are urged to declare their major upon first entry to the university or as soon thereafter as possible by contacting the college advisement center (264 CB).

Professional Program

Admission to the professional program is available to all students in good academic standing with the university who have:

a. passed the pre-requisite courses for the first semester professional courses, namely ChEn 273 and Math 302,
b. submitted to the department a completed Application for the Chemical Engineering Professional Program.

The Application for the Chemical Engineering Professional Program requires the student to meet with his/her department advisor for direction and counseling concerning performance in the pre-professional program classes and successful completion of the professional program.

With the exception of ChEn 378 and ChEn 310, none of the required 300- or 400-level courses in chemical engineering may be taken before acceptance into the professional program.

1. Application Procedures

Applications for the professional program are due each April 15, but may be submitted any time prior to that date. All students who will meet the professional program requirements by Fall semester should submit the application by April 15 even if completion a prerequisite class will not occur until Spring Term. Application forms are available at the department office. The application form includes a tentative plan for graduation and major elective classes. The student completes these parts of the application and then meets with his/her advisor in advance of the April 15 deadline. All completed applications must include the advisor's signature.

Transfer students should submit an application to the department for admission to the professional program concurrently with their application to the university. Transfer student applications do not require meeting with an advsior or an advisor's signature. However, transfer students should meet with their advisor shortly after arriving on campus.

2. Professional Program Advising

There is a strong correlation between successful completion of the professional program and student performance in "key performance indicator courses" in the pre-professional program. Key performance indicator courses are shown in shaded boxes on the flow charts.

The key performance indicator courses are:

Math 112, 113, 302, 303
Chem 111, 112 (or 105, 106, 107); 351, 352
ChEn 170, 263, 273
Phscs 121, 220

Poor grades in these classes suggest inadequate preparation for professional program class work or a poor match between student aptitudes and the skill set required in the chemical engineering major.

Academic Standards and Continuance

On gaining acceptance to the professional program, students must maintain the following minimum academic standards. Failure to do so may result in being terminated from the program.

a.The student's academic standing with the univeristy must be "Good" or "Previous" to enroll in professional program courses.

b. Anyone who accumulates grades below C- in excess of 6 hours in chemical engineeing courses may not take further chemical engineering until he or she has reduced the number of credits of each unacceptable grade to 6 hours or less.

c. A student may not graduate with more than 3 hours below C- in chemical engineering courses.

*Professional program courses are defined as the following—courses listed in **Major Requirements** items 2 and 4, plus Stat 361 and Chem 461.

General Information

Transfer Students. Provisions have been made so that a qualified student transferring from a junior college or from another university, college, or department, who has completed the equivalent of the first two years of the academic program, can complete the B.S. degree requirements in approximately two years. Students considering transferring should contact the department at the earliest date possible so that a program can be tailored to accommodate individual backgrounds.

Integrated Master's Program. At the end of the Sophomore year or during the Junior year, a student who desires to obtain a master's degree in chemical engineering may elect to enter the integrated master's program. The purpose of this program is to afford greater flexibility in scheduling course work than is normally available through the sequential completion of the B.S. and the M.S. degree programs, and to permit an early start on the M.S. thesis work. In this program, students may work toward both the bachelor's and master's degrees simultaneously, either receiving the B.S. degree before or at the same time as the M.S. degree. At the end of the Sophomore year students must have a cumulative GPA of 3.4 or higher. All credit to be counted toward the master's degree must carry a cumulative GPA of 3.0 or better.

Before completing the final 32 hours of undergraduate course work, students should submit a formal application for admission to the graduate program to the Office of Graduate Studies. Additional details may be obtained from the college advisement center.

Professional Registration. Chemical engineers can become licensed as professional engineers (P.E.'s). General qualifications for obtaining a P.E. license are explained in the College of Engineering and Technology section of the undergraduate catalog. Some states require this status for consulting and practice in the private or public sector. The basic chemical engineering program prepares graduates to successfully complete the Fundamentals of Engineering (FE) examination, which is the first step in licensure. Students who wish to become professional engineers are encouraged to talk to their advisor about preparing for the FE exam.

B.S. Chemical Engineering (99.5-101.5 hours*)

Students are strongly encouraged to consult with the department about their personal course scheduling.

Major Requirements

1. Complete the following pre-professional courses:

Math 112 Calculus 1		4.0
(Prerequisite: Math 110 and 111 or equivalents)		
Math 113 Calculus 2		4.0
Math 302 Advanced Engineering Mathematics		4.0
Math 303 Ordinary Differential Equations		4.0
Either	Chem 111 Principles of Chemistry	3 0
	Chem 112 Principles of Chemistry	3.0
Or	Chem 105 General College Chemist	4.0
	Chem 106 General College Chemist	3.0
	Chem 107 General College Chemist	1.0
ChEn 170 Introduction to Chemical Engineering		2.0
ChEn 263 Prob. Solv. Tech. for Chemical Engrs.		2.0
ChEn 273 Chemical Process Principles		3.0
ChEn 291R Pre-professional Seminar		0.5
Chem 351 Organic Chemistry		3.0
Chem 352 Organic Chemistry		3.0
Phscs 121 Principles of Physics		3.0
Phscs 220 Principles of Physics		3.0

2. Complete the following professional courses:

ChEn 311 Chemical Engineering & Society	3.0
ChEn 373 Chemical Engineering Thermodynamics	3.0
ChEn 374 Fluid Mechanics	3.0
ChEn 376 Heat and Mass Transfer	3.0
ChEn 378 Science of Engineering Materials	3.0
ChEn 391 Chemical Engineering and Career Skills	1.0
ChEn 436 Process Control and Dynamics	3.0
ChEn 451 Chem. Engr. Plant Des. & Process Syn.	4.0
ChEn 475 Unit Operations 1	2.0
ChEn 476 Separations	3.0
ChEn 477 Unit Operations 2	2.0
ChEn 478 Chemical Reaction Engineering	3.0

3. Complete the following supporting courses:

Stat 361 Quality Improvement		3.0
Engl 316 Technical Writing		3.0
Chem 461 Physical Chemistry		3 0
Biol 100 Principles of Biology		3.0
Either	Econ 110 Economic Princ. and Probl.	3.0
Or	EngT 200 Global Technology Issues	3.0

4. Complete technical electives (12 hours minimum) satisfying the following requirements (see table on next page for examples of technical electives focused on specific emphasis areas):

(1) Complete 2 hrs of chemistry laboratory [Chem 213(2), 353(1 or 2), or 464 (1 or 2)].
(2) Complete 6 hrs. of advanced (> 300 level) engineering course work from one of the following departments: ChE, CE, ECE, ME or the Technology school.
(3) Complete 4 hrs. of advanced (> 300 level) course work from an engineering, math, science, or business (EMSB) department.
Chem 367 and 391 are not acceptable; only I hour of Chem 497 is acceptable. No more than 2 hours of ChEn 498R (only I hour if Chem 497R is taken) may be applied to the program. Phscs 281 is an approved course for this requirement.

*Hours include courses that may fulfill G.E. or university requirements.

General Education Core Requirements

The university's general education program is designed to broaden your education and enrich your experience at the university. However, because of the large number of courses required for graduation in chemical engineering, it is desirable to be as efficient as possible in fulfilling course requirements. A full description of the current GE program can be found in the Class Schedule (see online version for the most recent information) and should be studied carefully. The following guidelines show the most efficient plan for satisfying the GE core.

1. GE Requirements Automatically Satisfied by the Major Requirements.
    a. Quantitative reasoning is satsified by Math 112
    b. Languages of Learning is satisfied by Math 302
    c. Communication – the Advanced Writing requirement is satisfied with Engl 316
    d. Biology is satisfied with Bio 100
    e. Physical Science is satisfied by Phscs 121 and Chem 111
    f. Social Science is satisfied by Econ 110
2. GE Requirements that can be Double Counted
    a. Arts and Letters. The university requires one Arts and one Letters class from the list of approved classes. However, almost all of the History of Civilization II courses double count for either Arts or Letters. Therefore, the most efficient way to meet the Arts and Letters requirements is to: 1) Take an ARTS course and a CIV II course that counts for LTRS, or 2) Take a LTRS course and a CIV II course that counts for ARTS.
    b. Global and Cultural Awareness (GCA). This general education requirement can be met by taking a religion course or courses that will count towards both the religion requirement and the GCA requirement. Currently, the options are to take Religion 351 (World Religions: 3 credits) or the two course sequence of Religion 355 and 356 (1credit hour each). Either of these course options will allow you to take advantage of double counting by providing credit hours towards the religion credit requirement and by completing the GCA GE requirement. For those with mission-related or other extensive language experience, the GCA requirement can also be completed by taking the culminating course for the particular language (see table in Class Schedule for a listing of courses). While this culminating language course is in addition to department and university minimum requirements, students often elect to take this course to solidify language abilities and to obtain university credit for the skills that they have developed.
3. In addition to the requirements listed in 1 and 2, the following GE core requirements must be met:
    a. English 150 (or 115) (3)
    b. American Heritage 100 (3)
    c. CIV I (3)
    d. Wellness P.E. (3 courses) (1.5) or HEPE 129 (2)
    e. Religion (7 total courses, including 2 Book of Mormon, Doc. & Cov., New Testament and any course used to double count with GCA – see item 2b) (14)

The total number of hours required for a B.S. in Chemical Engineering is 130-132.5.

Samples of how electives can be chosen to focus on a particular specialty

Elective Requirements	**Bioengineering**		**Semiconductor Engineering**		**Environmental Engineering**	
2 hours of Chemistry Laboratory	Chem 353	2	Chem 353 Chem 464	1 1	Chem 213	2
6 hours of Advanced Engineering	ChEn 518 ChEn 578	3 3	ChEn 381 ECEn 450	3 3	ChEn 310 ChEn 411 or 511	3 3
4 hours of Advanced Engineering, Math, Science, Business Management	Chem 481 ChEn 500 or ChEn 498R	3 1	Phscs 281 Phscs 340	3 1	Chem 596R or CEEn 550 ChEn 500 or ChEn 498R	3 1
Total ≥ 12 hours		12		12		12

Elective Requirements	**Thermophysical Properties**		**Combustion Engineering**		**Graduate School**	
2 hours of Chemistry Laboratory	Chem 464	2	Chem 353	2	Chem 353 Chem 464	1 1
6 hours of Advanced Engineering	ChEn 531 Other ChEn elect.	3 3	ChEn 310 ChEn 411	3 3	ChEn 541 Other ChEn elect.	3 3
4 hours of Advanced Engineering, Math, Science, Business Management	Chem 462 ChEn 498R	3 1	MEEn 541 ChEn 498R	3 1	Math 347 ChEn 498R	3 1
Total ≥ 12 hours		12		12		12

CHEMICAL ENGINEERING PROGRAM
REQUIREMENTS FOR THE B.S. DEGREE
Updated June 8, 2004

MAJOR REQUIREMENTS

BASIC SCIENCE

Chemistry: 111 (3) F
112 (3) W
or 105 (4) F W Sp Su
106 (3) F W Sp Su
107 (1) F w Sp Su

351 (3) F W Sp
352 (3) F W Sp Su
461 (3) F W

Physics: 121 (3) F W Sp Su
220 (3) F W Sp Su
Biology: 100 (3) F W Sp Su

MATHEMATICS

112 (4) F W Sp Su
113 (4) F W Sp Su

302 (4) F W
303 (4) F W
or 214 (3) F W Sp Su
334 (3) F W Sp Su
343 (3) F W Sp Su

CHEMICAL ENGINEERING

170 (2) F W
291R (0.5) F W
263 (2) F Sp
273 (3) W Sp
311 (3) F
373 (3) W
374 (3) F
376 (3) W
378 (3) F
391 (1) F W
436 (3) F
451 (4) W
475 (2) F Sp
476 (3) F
477 (2) W Sp
478 (3) W

OTHER COURSES

Statistics 361 (3) F W Sp
English 316 (3) F W Sp Su
Economics 110 (3) F W Sp Su
or
Engineering & Technology 200 (3) F

TECHNICAL ELECTIVES
(Upper Division)

Chemistry Lab	(2)
Engineering	(6)
Engineering, Math, Science, Business Management	(4)
	(12)

G.E. CORE REQUIREMENTS

Doctrinal Foundation

Book of Mormon (2 courses)	(4)
Doctrine & Covenants	(2)
New Testament	(2)
Religion Electives	(6) **
	14

Individual and Society

American Heritage 100	(3)
Wellness P.E. (3 courses)	(1.5)
OR HEPE 129	(2.0)
GCA	(3.0)**

Skills

English 150 (or 115)	(3)
Adv. Writing (Engl. 316)	*
Quant. Reasoning	*
Language of Learning	*

Arts, Letters and Science

Arts elective	(3)**
Letters elective	(3)**
Biology	*
Physical Science	*
Civ I and II	(6)**
Social Science (Econ 110)	*

*These courses/areas are satisfied by courses shown in the Major.
**It is recommended that courses be carefully selected to double count. Reduction of total credits is recommended by satisfying the GCA requirement using either 1) RelC 351 or a combination of RelC 355 and 356 (double counting as religion electives) or 2) a combination of a foreign-language mission with the 300- or 400-level foreign language culminating course. Furthermore, the Civ II class will double count as either the Arts or the Letters elective.