

# IOWA STATE UNIVERSITY

*Helping you become your best.*

Department  
of  
**Chemical and Biological  
Engineering**

## **Undergraduate Booklet**

**2009-2010 Catalog  
Revised May 2009**

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<http://www.cbe.iastate.edu/booklet09.pdf>**

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## Important Deadlines & Dates 2009-2010

	<u>Fall 2009</u>	<u>Spring 2010</u>
Classes Start (call instructor if you miss first day)	8/24	1/11
Undergraduate graduation applications (forms in 2162 Sweeney or <a href="http://www.public.iastate.edu/~registrar/forms/gradapp.pdf">www.public.iastate.edu/~registrar/forms/gradapp.pdf</a> ) due in Registrar's Office, 10A Alumni Hall	5/1	12/11
Fee Payment Due	8/20	1/20
University holiday, offices closed, classes not in session	9/7	1/18
Second half-semester courses begin (Midterm)	10/19	3/8
Web Registration (for the next term) Start (Make an appointment to see your advisor)	10/22	3/23
Schedule Changes (Forms in 2162 Sweeney)		
Last day through AccessPlus	8/28	1/15
Last day without fee	8/28	1/15
Last day to drop without appearing on permanent record or counting toward total course drop limits	8/28	1/15
Last day to change a course from audit to credit	8/28	1/15
Last day to change from Pass-Not Pass to grade basis without counting toward total Pass-Not Pass allowance	9/4	1/25
Last day to elect to audit a course – instructor must approve	9/4	1/25
Last day to drop without extenuating circumstances	10/30	3/26
Last day to indicate a non-automatic designated repeat	10/30	3/26
Last day to change to or from Pass/Not Pass basis. Course will count toward the total P/NP credits allowed.	10/30	3/26
Break	11/23-27	3/15-19
Final Exams (schedule on web from beginning of semester) <a href="http://www.iastate.edu/~registrar/exams/">http://www.iastate.edu/~registrar/exams/</a>	12/14-18	5/3-5/7

## Introduction

This booklet has been prepared to help you plan your program in Chemical Engineering at Iowa State University and is intended to guide you through the chemical engineering curriculum, to describe various opportunities and options, and to relay important policies and procedures. Other information sources are:

- ◆ General Catalog (curriculum and course information)
  - <http://www.public.iastate.edu/~catalog/>
- ◆ Schedule of Classes
  - <http://classes.iastate.edu/>
- ◆ ISU Information Handbook (academic regulations)
  - <http://policy.iastate.edu/>
- ◆ ISU Academic Calendar
  - <http://www.iastate.edu/~registrar/calendar/>
- ◆ ISU Academic Information Technologies
  - <http://www.it.iastate.edu/>
- ◆ Academic Departments at ISU
  - <http://www.iastate.edu/depts/>
- ◆ Chemical & Biological Engineering Department
  - <http://www.cbe.iastate.edu/>
- ◆ ISU Registrar Forms
  - <http://www.iastate.edu/~registrar/forms/>
- ◆ Student Answer Center
  - <http://www.public.iastate.edu/~registrar/AnswerCenter/homepage.html>
  - <http://www.public.iastate.edu/~saff/students.html>
- ◆ Course Equivalency Guide
  - <http://www.admissions.iastate.edu/equiv/index.php>
- ◆ Experimental (###X) Course Descriptions
  - <http://www.public.iastate.edu/~catalog/exp/>
- ◆ College of Engineering
  - <http://www.eng.iastate.edu/>
- ◆ Premed Information
  - <http://www.las.iastate.edu/academics/prehealth>
- ◆ Pre-Law Information
  - <http://www.las.iastate.edu/academics/prelaw.shtml>
- ◆ Scholarship Information
  - <http://www.financialaid.iastate.edu/>
  - <http://www.eng.iastate.edu/scholarships/>
  - <http://fastweb.com/>
  - <http://www.scholarshiphelp.org/>
  - <http://federalstudentaid.ed.gov/>
  - <http://www.finaid.org/>
- ◆ Student Organizations
  - <http://sodb.stuorg.iastate.edu/>
- ◆ Tuition & Fees
  - <http://www.iastate.edu/~registrar/fees/>
- ◆ Weather
  - <http://www.iastate.edu/cgi-bin/weather/>
- ◆ Writing Center
  - <http://isucomm.iastate.edu/wmhc/index.html>
- ◆ *The Iowa State Daily*
  - <http://www.iowastatedaily.com/>
- ◆ The undergraduate bulletin board at the east entrance of Sweeney Hall
- ◆ The Chemical Engineering Student Services Office in Room 2162 Sweeney Hall

# *Part 1: General Information*



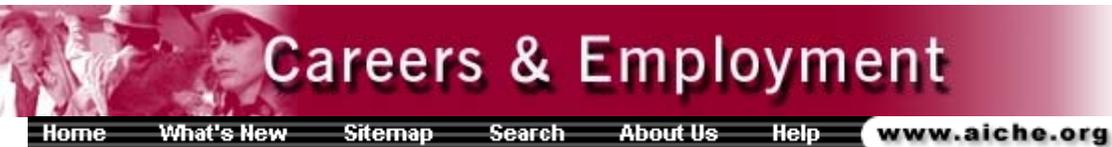
## The Profession of Chemical Engineering

Chemical engineering is an exciting and diverse profession with a tremendous range of occupations and opportunities. Chemical engineers have always been proud of their flexibility. A solid and very general technical background enables them to work effectively in and adapt quickly to many different fields.

The chemical engineer is an expert at dealing with the chemical and physical changes of matter and with the conversion of energy. Most chemical engineers use this knowledge in jobs that involve the application of chemical research to the production of chemical materials and products. This entails product development and market research; economic feasibility studies; research; development and design of chemical processes; design of process equipment; supervision of the construction, start-up, operation, and maintenance of chemical plants; and process improvement for pollution control and energy conservation.

Chemical engineers are found working in such diverse areas as business, applied physics, manufacturing, applied mathematics, biochemistry, medicine, patent law, food processing, pollution monitoring and prediction, sales, and industrial management. All of these are in addition to the already wide range of types of jobs traditionally thought of as chemical engineering jobs.

Chemical engineers are employed in a wide variety of industries: petroleum and gas, chemicals, minerals and metals; glass and ceramics; plastics and resins; soap and detergents; cosmetics; rubber and tire; food production; fertilizer and agricultural chemicals; nuclear energy; photographic products; microchip manufacturing; missile and space; synthetic fibers and textiles; paint, paper, and cellulose; pharmaceuticals; and process equipment manufacture. They are also involved in private consulting, government, and higher education.



**Careers & Employment**

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The American Institute of Chemical Engineers' web address for career information is:  
<http://www.aiche.org/careerservices/studentempl/>

## Chemical & Biological Engineering Facilities

Sweeney Hall (which is open from 7 a.m. to 12 midnight Monday-Friday, 7 a.m. to 9 p.m. on Saturday, and noon to midnight on Sunday except holidays) houses classrooms, a reading room, computer laboratories, research and teaching laboratories, and departmental and staff offices. You are invited to stop in at any of the research labs and ask about the research work in progress.

The instructional laboratories and additional faculty offices and research laboratories are located in the new addition to Sweeney Hall at the west end of the complex. Take a look at the equipment in the laboratory area — you will probably see some equipment familiar to you, and you can find out about the unfamiliar items by asking any staff member.

### Department Administration

The department office and the office of the Chairman are located in 2114 Sweeney Hall. The department office telephone number is 294-7642. The CBE Student Services Office is located in 2162 Sweeney Hall; the telephone number is 294-7643.

### Reading Room

Room 3149, on the third floor is a large reading room, which is open each day from 8 a.m. to 5 p.m. It contains a large collection of reading material including pertinent chemical engineering journals, job information, and graduate school information.

### Undergraduate Student Lounge

Students have an additional place to study or just hang out in 0107 Sweeney. Comfortable seating, tables with chairs, a phone, and several computers are available in this room.

## Small Group Meeting Rooms

Two rooms (1153 & 1157 Sweeney) have been set aside for undergraduate students to use for studying or working on projects. No reservations are necessary. If you do want to ensure that the room will be available at a particular time, just hang a note on the door before hand.

## Computation Laboratories

The Chemical & Biological Engineering Department has a growing list of computer resources available to undergraduate students. The Chemical Engineering Department has two main laboratories devoted to undergraduate student use. Rooms 1133 and 1150 are open to all ChE students, but are primarily utilized by undergraduates. Room 1150 is reserved for classes several hours during the week. Other labs across campus offer computers for general use.

**INSTALLATION OF PERSONAL SOFTWARE IS PROHIBITED ON THESE MACHINES**

Visit <http://it.eng.iastate.edu/> to obtain an account and to request support for computer and printing problems. This web page also contains descriptions of the hardware and software available in every College of Engineering computer lab.

**Support:** Don Schlagel (schlagel@iastate.edu) is the computer support specialist for CBE and is located in 1144 Sweeney Hall. If he is unavailable, you can request help from the college computer support at <http://it.eng.iastate.edu/request-support.html>.

## Release of Student Information

In this department we routinely get requests from employers and graduate schools to provide names of potential candidates to aid them in their recruitment. We will provide such lists, with directory information, unless you request that we not include you in such releases. We do not release individual GPA information unless the student has authorized the organization to request it. You may request exclusion by submitting a written request to Christi Patterson in the Student Services Office, 2162 Sweeney.

## Advising

The department has a dual-advising system. The initial point of contact for most advising issues will be the advising coordinator in 2162 Sweeney. The advising coordinator will help you with routine matters such as degree audit corrections, answering policy/procedure questions, handling scheduling difficulties, and guiding you to campus resources. You will also see the advising coordinator for registration advising (registration deadlines are given at the beginning of the booklet) and to pick up registration materials. Shortly after enrolling in ChE 210, you will also be assigned to a faculty advisor. You should visit with your faculty advisor to discuss your progress and academic goals, for choosing a package of electives, for help in formulating career goals, for answers to questions about the profession of chemical engineering, for help in applying to graduate school, and for any other issue that requires faculty expertise.

Students are expected to plan their Program of Study (POS) and choose courses to meet the elective requirements for a more intentional college experience. The POS form (page 23) will be introduced in the semester the student is enrolled in ChE 210 during registration for the following term to allow for time to complete the form and meet your faculty advisor before the next term. Degree Audits (DA) show your progress towards completing degree requirements and are printed each fall and spring semester at the same time that RAN sheets are printed for registration. Students will receive their current DA and RAN sheet from the ChE advising coordinator (terms prior to, and including, the semester you are enrolled in ChE 210), their faculty advisor (after completing ChE 210 and having a faculty advisor assigned, but not having completed a POS), or the Student Services Office (after having completed and faculty advisor has signed the POS). Students on Academic Warning or Probation must see their advisor to discuss their options for the DA and RAN sheet. Students will meet with their faculty advisor for their DA and RAN sheet during the registration period prior to their graduation term.

**Your faculty advisor is the primary source for:**

Developing an elective package  
Information about the profession  
Career and profession issues  
Working on a degree program  
Discussing undergraduate independent study projects  
Getting a recommendation letter  
Learning about graduate school

**The ChE Advising coordinator can help with:**

How to add or drop a course, or register  
Getting copies of forms you need  
Information about degree requirements  
Resolving course scheduling problems  
Signing co-op and internship forms  
Getting copies of department publications  
Finding another advisor if yours is unavailable  
Help with deciding to add or drop a class

## **Academic Integrity**

It is imperative that society be able to rely upon the integrity of the members of our profession. At the university, faculty expect students to follow high ethical standards in their academic work. Rules and procedures regarding actions that constitute academic dishonesty are included in the Iowa State University Information Handbook. These apply to all students. In addition, the chemical engineering faculty have adopted the following policy statement, which applies in chemical engineering courses.

The faculty expect that work submitted in your name be entirely your own work. You should not copy assignments, exams, quizzes, computer programs, etc. from others or allow copying of your work. It is usually permissible to discuss homework assignments with other students, unless your instructor specifies to the contrary. For examinations and quizzes a stricter standard is imposed. For exams and quizzes the presumption, unless otherwise stated, is no discussion, no use of notes, no use of books or journals, and no use of work of others. If in a particular instance the instructor wishes to modify any part of the department policy, you will be so informed in writing.

## **American Institute of Chemical Engineers (AIChE) Code of Ethics**

Members of the American Institute of Chemical Engineers shall uphold and advance the integrity, honor, and dignity of the engineering profession by: being honest and impartial and serving with fidelity their employers, their clients, and the public; striving to increase the competence and prestige of the engineering profession; and using their knowledge and skill for the enhancement of human welfare. To achieve these goals, members shall:

- ◆ Hold paramount the safety, health and welfare of the public and protect the environment in performance of their professional duties.
- ◆ Formally advise their employers or clients (and consider further disclosure, if warranted) if they perceive that a consequence of their duties will adversely affect the present or future health or safety of their colleagues or the public.
- ◆ Accept responsibility for their actions, seek and heed critical review of their work and offer objective criticism of the work of others.
- ◆ Issue statements or present information only in an objective and truthful manner.
- ◆ Act in professional matters for each employer or client as faithful agents or trustees, avoiding conflicts of interest and never breaching confidentiality.
- ◆ Treat fairly and respectfully all colleagues and co-workers, recognizing their unique contributions and capabilities.
- ◆ Perform professional services only in areas of their competence.
- ◆ Build their professional reputations on the merits of their services.
- ◆ Continue their professional development throughout their careers, and provide opportunities for the professional development of those under their supervision.
- ◆ Never tolerate harassment.
- ◆ Conduct themselves in a fair, honorable, and respectful manner.

## Tornado/Severe Weather Guidelines

If your area is threatened by a tornado, the thought that should be uppermost in your mind is how to save lives, not possessions. Time is of the essence. You may only have time to duck under a sturdy table or get into an interior hallway.

**DO NOT** activate the fire alarm!

- ⚡ Seek safe places for shelter, such as steel-reinforced office buildings, storm shelters, tunnels, sub-basements, underground parking facilities, basements, and interior corridors.
- ⚡ Keep away from windows, structures with large free-span roofs such as auditoriums and gymnasiums, the upper stories of multi-story buildings, house trailers and parked cars.
- ⚡ An automobile, whether parked or moving, is the most dangerous place to be. Violent winds can tumble a car over and over, crushing it and its occupants. Seek shelter immediately. Do not attempt to drive out of the storm path, because this has proven fatal to many motorists. If you are trapped in open country, seeking shelter in a ravine or ditch may be your only hope. However, be aware of the torrential rains that often accompany tornadic weather.
- ⚡ If you are in an office building, dormitory, or any other multi-story structure, go to interior hallways on a lower floor, preferably in the basement. In homes, a basement usually offers the greatest safety. If no basement is available, take cover under heavy furniture in the center of the house against strong inside walls. Covering yourself with a rug or blanket provides some protection against flying glass and falling debris. If you are in a mobile home park, or any non-reinforced structure without a basement, seek shelter elsewhere, such as a public building, friend's basement, community shelter, etc. At shopping centers, stay away from large glass windows. If possible, take cover under a strong counter.
- ⚡ No matter where you are, do some advance planning. Identify protective areas you can get to in a hurry.
- ⚡ Take responsibility for receiving your own several weather notifications — sign up for an e-mail or text alert from your local TV station's website.

### Severe Weather Definitions

<b>Tornado Watch</b>	Conditions are favorable for tornadoes (or severe thunderstorms) to occur. Stay informed.
<b>Tornado Warning</b>	A tornado or severe thunderstorm is occurring or is imminent. Seek shelter immediately.
<b>Severe Thunderstorm</b>	A storm that produces wind damage, dime-size hail or larger and winds up to 58 mph.
<b>Tornado</b>	A violently rotating column of air in contact with the ground and coming from a thunderstorm.
<b>Funnel cloud</b>	Similar to a tornado, but not in contact with the ground.

**NOTE:** At Iowa State, all the permanent brick and stone buildings on central campus are of reinforced construction and offer good shelter. Remember to stay away from outside windows and doors and go to interior hallways and basements if possible. If you live in university housing, be sure to review the information and instructions the Residence Department has provided on tornado safety routines.

## **Part 2: Curriculum & Requirements**



## Outcomes of the Program

The chemical engineering program should produce graduates that have:

- ◆ An ability to apply knowledge of mathematics, science, and engineering
- ◆ An ability to design and conduct experiments, as well as to analyze and interpret data
- ◆ An ability to design a chemical engineering system, component, or process to meet desired needs
- ◆ An ability to function on multi-disciplinary teams
- ◆ An ability to identify, formulate, and solve chemical engineering problems
- ◆ An understanding of professional and ethical responsibility
- ◆ The ability to communicate effectively
- ◆ The broad education necessary to understand the impact of chemical engineering solutions in a global and societal context
- ◆ Recognition of the need for, and an ability to engage in life-long learning
- ◆ A knowledge of contemporary issues
- ◆ The ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- ◆ Demonstrated thorough grounding in chemistry and a working knowledge of advanced chemistry such as organic, inorganic, physical, analytical, materials chemistry, or biochemistry
- ◆ A working knowledge, including safety and environmental aspects, of material and energy balances applied to chemical processes; thermodynamics of physical and chemical equilibria; heat, mass, and momentum transfer; chemical reaction engineering; continuous and stage-wise separation operations; process dynamics and control; process design; and appropriate modern experimental and computing techniques
- ◆ An ability to function as engineers in an international setting
- ◆ An ability to function as professional engineers in the industries related to chemical engineering
- ◆ An ability to pursue research and advanced studies in chemical engineering or in related fields such as medicine, law, and business.

## Basic Program Requirements

Engineering students are required to complete certain basic courses as a condition of enrollment in engineering courses at the 200-level or above. The general requirement is to complete the basic engineering program with a quality point average of 2.00 or better, including transfer courses. The basic program courses are:

Mathematics 165, 166  
English 150, 250  
Engineering 101, 160

Chemistry 177 (or 167)  
Physics 221  
Library 160

Prior to satisfying the basic program requirement, a chemical engineering student may (if otherwise qualified) enroll in 200-level or above engineering courses for no more than one semester.

For transfer students, enrollment is permitted for no more than two semesters prior to satisfying the basic program requirement. For transfer students, certain waivers and substitutions are possible and should be discussed with the academic advisor as early as possible. It is allowable to:

1. Substitute transfer credit for Engr 160 only if the coursework contains both engineering problem-solving and computer programming experience.
2. Substitute Chemistry 167 for Chemistry 177.

## Core Course Requirement

The College of Engineering requires that each student must have a minimum GPA of 2.00 in a group of 200-level and above courses to meet graduation requirements. The chemical engineering faculty have designated the following chemical engineering courses as core courses for this requirement: 210, 302, 310, 325, 356, 357, 358, 381, 382, 421, 426, and 430. The Advisement/Degree Audit form will show this grade average each semester under Chemical Engineering Core. Transfer credits will be included in this average. The cum GPA is calculated from all courses excluding transfer courses. This means the average will be for those courses that were actually taken at Iowa State.

## Design Experience

The design experience begins in the second year in ChE 210, Materials and Energy Balances, in which students are introduced to the design and computation tools that will be used in subsequent courses. Introduction to databases, data manipulation and reduction, and the use of numerical method packages are covered, along with the concept of optimization and economic design. The design experience then continues through the sequence of primarily engineering science courses — fluid mechanics, heat transfer, mass transfer, thermodynamics, reaction engineering, and process control. At least one organized design experience is in each of these courses.

Meanwhile, in the parallel two-semester sequence of chemical engineering laboratory courses there is a significant emphasis on the design process, and in each course the students design at least one new experiment. The senior elective courses include a design experience. Finally, the capstone design course, ChE 430, brings together all of these elements in an integrated design experience.

The overall plan is to distribute the process of learning to design chemical engineering processes, products, and systems throughout the curriculum in a continuous experience.

## Social Science and Humanities (SSH) Electives

SSH requirements include:

- Minimum of 15 credits from the list of approved courses below
- At least 6, but no more than 9, credits must be in the same department

Students must take 3 credits from the US Diversity Requirement list and 3 credits from the International Perspectives Requirement list. If those courses are also on the following SSH list, they would fulfill both SSH and either Diversity or International requirements. If the chosen US Diversity or International Perspective course is not on the SSH list, additional SSH credits must be taken to meet the minimum 15 SSH credits.

The following list of approved SSH's have notations if they also meet the US Diversity or the International Perspectives requirement. **Refer to the online list for a more complete listing of US Diversity and International Perspectives (<http://www.iastate.edu/~registrar/courses/div-ip-guide.html>).** *Note, that for departments that most courses are acceptable, not all courses in that department are listed below, only those courses that also meet US Diversity/International Perspectives requirements are specified.*

The International Perspectives requirement may be alternatively met with an academic experience involving a stay in a foreign country of three weeks or greater duration. A course involving travel abroad for less than three weeks is also approved for use in meeting the requirement if it carries three or more academic credits. International students are exempt from the International Perspectives requirement; however, the minimum 15 credits from the SSH list still needs to be met.

Applying Independent Study (490) courses for the Social Science and Humanities Electives will require **prior** approval by your advisor. Consult with your advisor for courses not on this list, such as Honors Seminars, experimental courses, or other courses that you think might qualify.

Dept Course #	US Div	Int'l Persp
<b>Acct</b>		
215		
<b>Af Am</b>		
201	X	
252^	X	
310^		X
311^		X
325		X
330	X	
333^	X	
334	X	
340^	X	
347	X	
348	X	
349^		
350	X	
353	X	
354	X	
381^		
395X	X	
460	X	
<b>Agron</b>		
342		X
<b>Am In</b>		
All courses except 490		
210	X	
240	X	
310	X	
315	X	
322	X	
323		X
328	X	
342	X	
346	X	
349x^	X	
380^	X	X
415^	X	
420	X	
432	X	
<b>Anthr</b>		
201		X
202		
230		X
250		X
306		X
307		
308		
309		X
311^		X
312^	X	
313		X
315	X	
317^		X
321		
322	X	
323		X
325		X
326		X
327		X
332^	X	
333^	X	
335		X

Dept Course #	US Div	Int'l Persp
<b>Anthr cont.</b>		
337		X
338^		
339^		X
340		X
344X^		X
411		X
412	X	
414		
415^	X	
416		
417^		X
418		X
420	X	
432	X	
436		X
439		X
442^		X
444		X
<b>Arch</b>		
221		X
222		X
420	X	
422		X
423		X
424		
425		
427		X
<b>Art</b>		
292	X	
<b>Art H</b>		
All courses except 490		
104X^		X
280		X
281		X
378		
380	X	
381		
382		X
384		X
394	X	
395^	X	
481		X
495	X	
<b>Biol</b>		
173		
307	X	
<b>Ch E</b>		
391A+B		X
<b>CI St</b>		
All courses except 480 & 490		
273		X
275		X
353		X
372		X
373		X
374		X
376		X
394		X
<b>Com Dis</b>		
286	X	

Dept Course #	US Div	Int'l Persp
<b>ComSt</b>		
323	X	
<b>C R P</b>		
253		
270	X	
290^		X
291		X
293		
317^		
376		
417		
484		
<b>CJ St</b>		
240		
241		
320		
332		
340		
341		
351		
352		
402		
<b>C I</b>		
430^		
<b>Dance</b>		
360		
<b>Dsn S</b>		
104X^		X
129^		
181		
221		X
222		X
270	X	
273^		X
280		X
281		X
291		X
293		
371		
373		X
380^		X
382		X
383		
385		
386^		
394	X	
417		
481		X
484		
487		
488		
495	X	
496		
498		
<b>Econ</b>		
101		
102		
301		
302		
312		
320		
321	X	
344		

Dept Course #	US Div	Int'l Persp
<b>Econ cont.</b>		
353		
355		X
362		
370		X
376		
380		
381		
382		
385		X
415		
448^	X	
455		X
470&		
480		
486X		
<b>Engr</b>		
327X		
340X		
<b>Engl</b>		
201		
205		
219		
225		
226		
227		
228		
230^		X
231^		
237		
240^	X	
260		
301^		
330		
<b>335 - 394 inclusive</b>		
340	X	
342X^	X	
344	X	
345	X	
346	X	
347	X	
348	X	
349	X	
352	X	
353		X
354		X
370		X
374		X
375		X
376		X
389		X
420		
422	X	
440		
441		
450		
452		
453^		
460		
461^		
463^		

Dept Course #	US Div	Int'l Persp
<b>Env S</b>		
173		
201		
293		
303^		
320		
334		
342		X
345		X
355		
380		
382		
384		X
425^		
442		
460		
472		
482		
484		
<b>FCEdS</b>		
379^	X	
421^		X
<b>FS HN</b>		
342		X
<b>Geog^</b>		
100^		X
324^		X
325^		X
327^		X
<b>Geron</b>		
377	X	
448	X	
461^		
476^	X	
<b>Hist</b>		
All courses except 490 & 495		
201		X
202		X
207		X
208^		X
240	X	
245		X
280		X
281		X
310^		X
311^		X
323		X
326^		X
336		X
337		X
338		X
339		X
341		X
345	X	
353	X	
354	X	
358		
371		X
374		X
376		X
380	X	
383		X
386	X	

Dept Course #	US Div	Int'l Persp
<b>Hist cont.</b>		
389		X
390		X
411^		X
412^		X
417^		X
420X		X
421		X
422		X
424		X
425		X
426^		X
443X		X
445X^	X	
473	X	
474X		X
475		X
476^		X
485^		X
<b>HD FS</b>		
102		
227		
239	X	
240	X	
270^	X	X
276	X	
349	X	
367		
377	X	
437^	X	
448	X	
479		
488		
<b>IE</b>		
325X	X	
<b>Int St</b>		
235		X
430		X
<b>Jl MC</b>		
101		
401		
461		
462		
464		
474		X
476		X
477	X	
<b>L A</b>		
271^		X
272	X	
273^		X
274	X	
371		
373		X
<b>LAS</b>		
150	X	
160X	X	
211	X	
222X	X	
235^		X
250		X
288X		
325	X	

Dept Course #	US Div	Int'l Persp
<b>LAS cont.</b>		
333X		
380	X	
385		X
430^		X
488X		
<b>Ling</b>		
119		X
219		
286	X	
309		X
420		
422	X	
463		X
498^		
<b>Mgmt</b>		
414		
<b>Mat E</b>		
391	X	
<b>Math</b>		
489		X
<b>M E</b>		
280		
281		
284		
285		
288^		
289^		
484		X
488		
489		
<b>Music</b>		
102		X
304		
383		X
384		X
471		
472	X	
473		
475		
476		
<b>Phil</b>		
All courses except 207 & 490		
235	X	
338	X	
<b>Pol S</b>		
All courses except 301,475 & 490		
241		X
251		X
332X	X	
341		X
345X	X	
347X		X
349		X
350		X
383X		X
385	X	
452		X
<b>Psych</b>		
101		
230		
280		
313		

Dept Course #	US Div	Int'l Persp
<b>Psych cont.</b>		
314		
346	X	
348		
360		
380		
381		
401		
436^	X	
437^	X	
460		
484		
488		X
<b>Relig</b>		
All courses except 490 & 499		
105^		X
205		X
210	X	
242		X
323		X
328	X	
333	X	X
334	X	
335X		X
336	X	
338		
340		X
342	X	
352		X
353		X
356		X
358		X
353		
354^		X
355X	X	
356		X
372^		X
376		X
384		X
395X		
<b>Soc</b>		
All courses beyond 130 except 202, 302, 412, 460, 464, & 490		
235	X	
327	X	
328	X	
330	X	
331	X	
332	X	
335x		X
345		X
411		X
431	X	
476^	X	
496^		X
<b>Sp Cm</b>		
205		
212		
323	X	
350		
417		

Dept	Course #	US Div	Int'l Persp
<b>T SC</b>			
	341		
	342		X
	343		
	474		X
<b>T C</b>			
	165	X	
	257		
	342^	X	
	354		X
	355^		X
	356		
	362		X
<b>Thtre</b>			
	110		
	252^	X	
	465		
	466		
<b>U St</b>			
	150	X	
	160	X	
	235^		X
	290N/490N	X	
	342		X
	385^		X
<b>W S</b>			
All courses except 258, 490, 491, & 499			
	201	X	
	203	X	
	205	X	
	222X	X	
	301		X
	302X	X	
	307	X	
	321	X	
	323	X	
	327	X	
	328	X	
	336	X	
	338	X	
	340	X	
	342	X	
	345	X	
	346	X	
	350	X	
	352	X	
	370		X
	374		X
	380	X	
	383^	X	
	385	X	
	386	X	
	394	X	
	420X ^	X	
	422	X	
	444		X

Dept	Course #	US Div	Int'l Persp
<b>W LC</b>			
All WLC courses except 490 & 499 for all curricula. NOTE: Students may not use grammar, conversational, or composition courses in the native language.			
	WLC 119		X
	WLC 278X		X
	484		X
<b>Arabc</b>			
	102X		X
	110X		X
<b>Chin</b>			
	102		X
	170X		X
	201		X
	202		X
	205X		X
	272X		X
	302		X
	370		X
	375		X
	472X		X
<b>Czech</b>			
	102		X
	201		X
	202		X
<b>Frnch</b>			
	102		X
	110^		X
	201		X
	202		X
	275X		X
	304		X
	321^		X
	322^		X
	331^		X
	332^		X
	333		X
	334^		X
	370		X
	375		X
	395		X
	440		X
	441^		X
	442^		X
	471		X
	472		X
	480^		X
	491^		X

Dept	Course #	US Div	Int'l Persp
<b>Ger</b>			
	102		X
	110^		X
	201		X
	202		X
	301		X
	305		X
	330		X
	370		X
	371		X
	378		X
	395		X
	471		X
<b>Greek</b>			
	102		X
	201		X
<b>Ital</b>			
	102		X
	201		X
	202		X
<b>Latin</b>			
	102		X
	201		X
<b>Polish</b>			
	102		X
	201		X
	202		X
<b>Port</b>			
	102		X
	112X		X
	211^		X
	201		X
	320X		X
	321		X
	340^		X
	341^		X
	440^		X
<b>Rus</b>			
	102		X
	195X		X
	201		X
	202		X
	295X		X
	370		X
	395		X
	441^		X
	442^		X
<b>SerbC</b>			
	102		X

Dept	Course #	US Div	Int'l Persp
<b>Span</b>			
	102		X
	110^		X
	160^		X
	195X		X
	201		X
	202		X
	290X		X
	295X		X
	314		X
	321		X
	322		X
	324		X
	326		X
	330		X
	331		X
	332		X
	370		X
	390X		X
	395		X
	441		X
	442		X
	443		X
	444		X
	445		X
	463		X
	494^		X

###^ – No longer offered at ISU.

###X – Experimental course; see <http://www.iastate.edu/~catalog/exp/> for description & scheduled offering.

## Biological Engineering Option

Students may enhance their academic preparation for the growing opportunities in the biological-related industries by adding the biological engineering option to the standard chemical engineering program. In addition to the elective choices listed on page 15, students may replace BBMB 301 with BBMB 404 and BBMB 405 or Biol 313 and Biol 314. BBMB 405 or Biol 314 can be used to meet Chemistry or Professional Elective requirements.

### Electives

The chemical engineering curriculum provides considerable flexibility, which allows students to tailor the curriculum to meet their own needs. The elective requirements are in social sciences/humanities and in technical areas including communications.

The chemical engineering curriculum includes 21 credits of technical electives to encourage students to develop an "area of emphasis." For example, a student may wish to take courses that will be good preparation for graduate school, or a student may wish to develop a stronger background in environmental engineering, biochemical engineering, biotechnology, or solid state (electronic or polymeric) materials processing. Each student **MUST** develop an area of emphasis in consultation with his/her faculty advisor. Be sure to plan early enough to permit taking necessary prerequisites. Suggestions for areas of emphasis are listed on pages 15 - 17.

**Important Note:** Some of the classes that are listed in the Iowa State Catalog as prerequisites for the technical electives listed on the following page may apply only to people in that specific area of study. Prerequisites may be waived by the course instructor if the course is being taken by someone outside of that department's curriculum. Always consult with your advisor and course instructor about waiving any prerequisites for your technical electives.

The various elective requirements are listed in Tables I and II.

**Table I - Electives**

	<b>MINIMUM CREDITS</b>
<b>Social Science &amp; Humanities electives:</b> (see page 10)	<b>15</b>
<b>Technical Electives</b>	<b>21</b>
<b>Communications electives:</b> Engl 309, Engl 312, Engl 314, or JI MC 347	3
<b>Advanced Chemistry electives:</b> Agron 320 Chem (210)*, 211, 211L, 301, 316, 316L, 321L, (322), 322L, 324, 331L, 332L, 333L, 334L, 401L, 402, 470 FSHN 311, 410 Mat E 311, 314, (315), 331, 351, 352, 423, 444, 453, 454 BBMB 311, 404, 405, 411, 420, 451, Biol (301), (301L), (302), (302L), 313, 313L, 314, 314L	3
<b>Statistics electives:</b> Stat 305, 231, 341, 342, 401, 495, 496	3
<b>Chemical Engineering electives:</b> These include ChE 406, 408, 415, 440, 442, (443), and any other ChE course not specified as required in the curriculum.	3
<b>Engineering electives:</b> Any 300+ engineering course outside of chemical engineering that does not repeat material in ChE courses. Approved exceptions: EM 274 & EE 201. Consult advisor for approval.	3
<b>Professional electives:</b> 300+ Physical Science, Life Science, Engineering, Statistics, Mathematics, or Computer Science Approved exception: Micro 201, 201L	6

\* (###) are course numbers from previous catalogs.

**Table II – Electives for Biological Engineering Option**

	<b>MINIMUM CREDITS</b>
<b>Social Science &amp; Humanities electives:</b> (see page 10)	<b>15</b>
<b>Technical Electives</b>	<b>21</b>
<b>Communications electives:</b> Engl 309, Engl 312, Engl 314, or JI MC 347	3
<b>Advanced Chemistry electives:</b> BBMB 405, 420 Biol 314	3
<b>Statistics electives:</b> Stat 305, 231, 341, 342, 401, 495, 496	3
<b>Chemical Engineering electives:</b> ChE 415, 440, 542, 562	3
<b>Engineering electives:</b> A E 373, 480 BRT 501 C E 421 MSE 580	3
<b>Professional electives:</b> ChE 415, 440, 542, 562, 490 <u>and one course from:</u> 300+ Life Science, Chem, FS HN, or BBMB (not BBMB 301)	6

Course descriptions may be found in the current ISU Catalog, which is available in hardcopy from the bookstores or online at: <http://www.iastate.edu/~catalog/>.

### **Suggested Emphases for Technical Electives (prerequisites & \*co-requisites)**

Listed below are courses that students may consider taking as part of their package of electives for various career paths. These lists are not exhaustive, and sometimes more courses are suggested than a student has time to take. All students should work closely with their faculty advisor to choose an appropriate set of electives to suit their individual career goals.

#### **General Graduate School Preparation**

##### ChE/Professional Electives

- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 490 (variable) Independent Study
- ChE 545 (3) Analytical and Numerical Methods (ChE 358 and Math 267)
- ChE 500-level courses

##### Professional Electives

- Math 307 (3) Matrices and Linear Algebra (2 semesters of calculus)
- Math 385 (3) Introduction to Partial Differential Equations (Math 265 and Math 267)

##### Statistics Elective

- Stat 305 (3) Engineering Statistics (Math 165)

##### Chemistry/Professional Electives

- Chem 324 (3) Introductory Quantum Mechanics (Chem 178, Math 166, Phys 222)

## **General Industrial Preparation**

### ChE/Professional Electives

- ChE 406 (3) Environmental Chemodynamics (ChE 381 and \*ChE 358)
- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)
- ChE 545 (3) Analytical and Numerical Methods (ChE 358 and Math 267)

### Engineering/Professional Electives

- IE 305 (3) Engineering Economic Analysis (Math 166)

### Statistics Elective

- Stat 305 (3) Engineering Statistics (Math 165)

## **Biochemical Engineering**

### ChE/Professional Electives

- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)
- ChE 562 (3) Bioseparations (ChE 357)

### Chemistry/Professional Electives

- Biol 313 (3) Principles of Genetics (Biol 211, 211L, 212, 212L)
- BBMB 404 (3) Biochemistry I (Chem 332)
- BBMB 405 (3) Biochemistry II (BBMB 404)

### Engineering/Professional Electives

- CE 421 (3) Environmental Biotechnology (CE 326)

### Professional Elective

- Micro 201 (2) General Microbiology (one semester of biology)
- BioE 411 (3) Bioprocessing and Bioproducts (AE 216, Math 165, Chem 177, Biol 173 or 211 or higher, or BRT 501, senior or graduate classification)

## **Biomedical Engineering**

### ChE/Professional Electives

- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)
- ChE 440 (3) Biomedical Applications of Chemical Engineering (ChE 210, Math 266, and Phys 222)
- ChE 562 (3) Bioseparations (ChE 357)

### Professional Elective

- Biol 335 (5) Plants and People (Biol 211 & 211L)
- BioE 341 (3) BioMEMs and Nanotechnology (BioE 202)
- BioE 352 (3) Molecular, Cellular, and Tissue Biomechanics (BioE 201, EM 324, MatE 272)
- BioE 450 (3) Biosensing (BioE 202)

### Chemistry/Professional Electives

- Biol 313 (3) Principles of Genetics (Biol 211, 211L, 212, 212L)
- Biol 314 (3) Principles of Molecular Cell Biology (Biol 313)
- BBMB 404 (3) Biochemistry I (Chem 332)
- BBMB 405 (3) Biochemistry II (BBMB 404)

## **Environmental Science and Engineering**

### ChE/Professional Electives

- ChE 406 (3) Environmental Chemodynamics (ChE 381 and \*ChE 358)
- ChE 408 (3) Surface and Colloid Chemistry (ChE 381)
- ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)

### Engineering/Professional Electives

- CE 326 (3) Principles of Environmental Engineering (Chem 178, Math 166, and \*EM 378)
- CE 420 (3) Environmental Engineering Chemistry (CE 326, Chem 177, Chem 178, and Math 166)
- CE 421 (3) Environmental Biotechnology (CE 326)
- CE 428 (3) Water and Wastewater Treatment Plant Design (CE 326)
- CE 529 (3) Hazardous Waste Management (CE 326)

### Professional Electives

- EnvS 324 (3) Energy and the Environment
- Geol 434 (3) Contaminant Hydrogeology (Geol 411 or equivalent)
- Mteor 404 (3) Global Change (four courses in physical or biological sciences or engr., Jr classification)

### Statistics Elective

- Stat 305 (3) Engineering Statistics (Math 165)

## **Food Engineering**

### Chemistry/Professional Electives

Biol 313 (3) Principles of Genetics (Biol 211, 211L, 212, 212L)

FSHN 311 (4) Food Chemistry (FS HN 203, TSM 115, Chem 331 & 331L, and \*BBMB 301)

### Engineering/Professional Electives

A E 451 (3) Food and Bioprocess Engineering (ChE 357 or FS HN 351 and Math 267)

### ChE/Professional Electives

ChE 408 (3) Surface and Colloid Chemistry (ChE 381)

ChE 415 (3) Biochemical Engineering (ChE 357, ChE 382, and Chem 331)

### Professional Electives

FSHN 412 (4) Food Product Development (FSHN 311 or 411 and FSHN 471)

FSHN 420 (3) Food Microbiology (Micro 201 or 302)

FSHN 421 (3) Food Microbiology Laboratory (Micro 201/201L or 302/302L, FSHN 420\*, FSHN 203\*)

FSHN 471 (3) Food Processing (Micro 201 or 302)

FSHN 472 (2) Food Processing Lab (FSHN 351, 471\*)

## **Materials Science**

### ChE/Professional Electives

ChE 442 (3) Polymers and Polymer Engineering (ChE 382 and Chem 331 or MatE 351)

### Chemistry/Professional Electives

Chem 301 (2) Inorganic Chemistry - non-metals (Chem 324)

Chem 402 (3) Advanced Inorganic Chemistry - metals (Chem 301, Chem 331 recommended)

MatE 454 (3) Polymer Composites and Processing (MatE 351)

Chem 576 (3) Surface Chemistry (Chem 324)

### Professional Elective

Phys 321 (3) Introduction to Modern Physics I (Phys 222 and Math 266\*)

Phys 322 (3) Introduction to Modern Physics II (Phys 321)

## **BioEngineering Minor**

The bioengineering minor at Iowa State University is an interdisciplinary program that complements a student's major discipline by providing additional insight into the interactions between various engineering disciplines and biological systems, emphasizing new ways of solving biological problems. The program provides students with unique educational experiences to apply engineering skills and create new biobased products and devices.

The program is open to all undergraduate engineering students at Iowa State University. This minor will provide students with a foundation of core Bioengineering knowledge, on which tracks will be superimposed to provide in-depth exposure to targeted areas of specialization. In addition to the core courses—BioE 201 and 202—students will complete coursework identified in the following tracks:

Bioinformatics and Systems Biology: BioE 325, BCB 211, 401, 402, & 442.

Biomaterials and Biomechanics: BioE 352, ChE 440, Ex Sp 355, & MatE 456.

Biomicrosystems: BioE 341, 341L, 450, 450L, & 428.

Biosystems and Environmental Engineering: AE 216, 480, BioE 411/511, ChE 415 and 427, & CE 421/521.

## Undergraduate Curriculum in Chemical Engineering *Biological Engineering Option*

2009-10 Catalog  
Total Credits = 125.5

### First Year (31.5)

#### Fall Semester (15.5)

4	+Math 165	Calculus I
3	+Engl 150	Crit. Think. & Comm.
4	+Chem 177	General Chemistry
1	Chem 177L	General Chemistry Lab
3	+Engr 160	Engineering Problems
R	+Engr 101	Engineering Orientation
0.5	+Lib 160	Library

#### Spring Semester (16)

4	+Math 166	Calculus II
3	Chem 178	General Chemistry
1	Chem 178L	General Chemistry Lab
5	+Phys 221	Intro. to Physics I
3		SS&H Elective

### Second Year (31)

#### Fall Semester (15)

3	* ChE 210	Material & Energy Bal.
4	Math 265	Multivariable Calculus
5	Phys 222	Intro. to Physics II
3	Chem 331	Organic Chemistry I

#### Spring Semester (16)

3	* ChE 356	Transport Phenomena I
4	Math 267	Differential Equations
3	Chem 332	Organic Chemistry II
3	Chem 325	Chemical Thermodynamics
3	+Engl 250	Written/Oral/Vis/Elect. Comp.

### Third Year (33)

#### Fall Semester (16)

3	* ChE 310	Computational Methods in ChE
3	* ChE 357	Transport Phenomena II
3	* ChE 381	ChE Thermodynamics
1	* ChE 302	Seminar
3		Statistics Elective
3	BBMB 301	Biochemistry <b>or</b>
	BBMB 404	Biochemistry I <b>or</b>
	Biol 313	Principles of Genetics

#### Spring Semester (17)

3		Communication Elective
3	* ChE 358	Separations
2	* ChE 325	ChE Laboratory I
3	* ChE 382	Chemical Reaction Engr
3		SS&H Elective
3	BBMB 420	Physiological Chemistry <b>or</b>
	BBMB 405	Biochemistry II <b>or</b>
	Biol 314	Molecular Cell Biology

### Fourth Year (30)

#### Fall Semester (15)

3	* ChE 421	Process Control
3		Engineering Elective
3		Professional Elective
3		SS&H Elective
3		SS&H Elective

#### Spring Semester (15)

4	* ChE 430	Process and Plant Design
3		Professional Elective
3		SS&H Elective
3		ChE Elective
2	* ChE 427	Biological Engr Laboratory

+ Basic Program – must earn a minimum GPA of 2.0 and must be completed the same semester as enrolling in the 1<sup>st</sup> 200-level Engr course.

\* ChE Core – must earn a minimum GPA of 2.0, including transfer credits

## Undergraduate Curriculum in Chemical Engineering Biological Engineering Option

2009-10 Catalog  
Total Credits = 125.5  
(prerequisites/\*co-requisites)

<b>Year 1</b>	F	<b>Math 165</b> 4	<b>Chem 177</b> (*Chem 177L) 4	<b>Chem 177L</b> (*Chem 177) 1	<b>Engr 150</b> 3	<b>Lib 160</b> 0.5	<b>Engr 160</b> 3	<b>Engr 101</b> R	15.5
	S	<b>Math 166</b> (Math 165) 4	<b>Chem 178</b> (Chem 177) (Chem 177L) 3	<b>Chem 178L</b> (Chem 177L) (*Chem 178) 1	<b>SSH Elec</b> 3			<b>Phys 221</b> (*Math 166) 5	16

<b>Year 2</b>	F		<b>Math 265</b> (Math 166) 4	<b>Chem 331</b> (Chem 178) 3	<b>ChE 210</b> (Chem 178) (Math 166) 3		<b>Phys 222</b> (Phys 221) 5	15
	S	<b>Engr 250</b> (Engr 150) (*Lib 160) 3	<b>Math 267</b> (Math 166) 4	<b>Chem 332</b> (Chem 331) 3	<b>Chem 325</b> (Chem 178) (Math 166) 3		<b>ChE 356</b> (ChE 210) (Phys 221) (*Math 267) 3	16

<b>Year 3</b>	F		<b>Stat Elec</b> 3	<b>1-BBMB 404</b> (Chem 332) or <b>2-BBMB 301</b> (Chem 331) or <b>3-Biol 313</b> (Biol 211/L) (Biol 212/L) 3	<b>ChE 381</b> (Chem 325) (Math 267) (Phys 222) (*ChE 310) 3	<b>ChE 357</b> (ChE 356) (*ChE 310) 3	<b>ChE 310</b> (ChE 210) (Engr 160) 3	<b>ChE 302</b> (Jr. classif.) 1	16
	S	<b>Comm Elec</b> 3	<b>SSH Elec</b> 3	<b>Chem Elec</b> 1-BBMB 405 (BBMB 404) or 2-BBMB 420 (Chem 332) (BBMB 301) or 3-Biol 314 (Biol 313) 3	<b>ChE 382</b> (ChE 310) (ChE 381) (*ChE 357) 3	<b>ChE 358</b> (ChE 310) (ChE 357) 3	<b>ChE 325</b> (ChE 357) (*ChE 381) 2		17

<b>Year 4</b>	F	<b>SSH Elec</b> 3	<b>SSH Elec</b> 3	<b>Engr Elec</b> 3	<b>Prof Elec</b> 3	<b>ChE 421</b> (Math 267) (*ChE 358) (*ChE382) 3		15
	S	<b>SSH Elec</b> 3		<b>ChE Elec</b> 3	<b>Prof Elec</b> 3	<b>ChE 430</b> (ChE 358) (ChE 382) 4	<b>ChE 426</b> (ChE 325) (ChE 358) (ChE 382) 2	15

# Undergraduate Curriculum in Chemical Engineering

2009-10 Catalog  
Total Credits = 125.5

## First Year (31.5)

### Fall Semester (15.5)

4	+Math 165	Calculus I
3	+Engl 150	Crit. Think. & Comm.
4	+Chem 177	General Chemistry
1	Chem 177L	General Chemistry Lab
3	+Engr 160	Engineering Problems
R	+Engr 101	Engineering Orientation
0.5	+Lib 160	Library

### Spring Semester (16)

4	+Math 166	Calculus II
3	Chem 178	General Chemistry
1	Chem 178L	General Chemistry Lab
5	+Phys 221	Intro. to Physics I
3		SS&H Elective

## Second Year (31)

### Fall Semester (15)

3	* ChE 210	Material & Energy Bal.
4	Math 265	Multivariable Calculus
5	Phys 222	Intro. to Physics II
3	Chem 331	Organic Chemistry I

### Spring Semester (16)

3	* ChE 356	Transport Phenomena I
4	Math 267	Differential Equations
3	Chem 332	Organic Chemistry II
3	Chem 325	Chemical Thermodynamics
3	+Engl 250	Written/Oral/Vis/Elect. Comp.

## Third Year (33)

### Fall Semester (16)

3	* ChE 310	Computational Methods in ChE
3	* ChE 357	Transport Phenomena II
3	* ChE 381	ChE Thermodynamics
3	BBMB 301	Biochemistry
1	* ChE 302	Seminar
3		Statistics Elective

### Spring Semester (17)

3		Communication Elective
3	* ChE 358	Separations
2	* ChE 325	ChE Laboratory I
3	* ChE 382	Chemical Reaction Engr
3		Chemistry Elective
3		SS&H Elective

## Fourth Year (30)

### Fall Semester (15)

3	* ChE 421	Process Control
3		Engineering Elective
3		Professional Elective
3		SS&H Elective
3		SS&H Elective

### Spring Semester (15)

4	* ChE 430	Process and Plant Design
3		Professional Elective
3		SS&H Elective
3		ChE Elective
2	* ChE 426	ChE Laboratory II

+ Basic Program – must earn a minimum GPA of 2.0 and must be completed the same semester as enrolling in the 1<sup>st</sup> 200-level Engr course.

\* ChE Core – must earn a minimum GPA of 2.0, including transfer credits

# Undergraduate Curriculum in Chemical Engineering

2009-10 Catalog

Total Credits = 125.5

(prerequisites/\*co-requisites)

<b>Year 1</b>	F	<b>Math 165</b> 4	<b>Chem 177</b> (*Chem 177L) 4	<b>Chem 177L</b> (*Chem 177) 1	<b>Engl 150</b> 3	<b>Lib 160</b> 0.5	<b>Engr 160</b> 3	<b>Engr 101</b> R	15.5
	S	<b>Math 166</b> (Math 165) 4	<b>Chem 178</b> (Chem 177) (Chem 177L) 3	<b>Chem 178L</b> (Chem 177L) (*Chem 178) 1	<b>SSH Elec</b> 3			<b>Phys 221</b> (*Math 166) 5	16

<b>Year 2</b>	F		<b>Math 265</b> (Math 166) 4	<b>Chem 331</b> (Chem 178) 3	<b>ChE 210</b> (Chem 178) (Math 166) 3		<b>Phys 222</b> (Phys 221) 5	15
	S	<b>Engl 250</b> (Engl 150) (*Lib 160) 3	<b>Math 267</b> (Math 166) 4	<b>Chem 332</b> (Chem 331) 3	<b>Chem 325</b> (Chem 178) (Math 166) 3		<b>ChE 356</b> (ChE 210) (Phys 221) (*Math 267) 3	16

<b>Year 3</b>	F		<b>Stat Elec</b> 3	<b>BBMB 301</b> (Chem 331) 3	<b>ChE 381</b> (Chem 325) (Math 267) (Phys 222) (*ChE 310) 3	<b>ChE 357</b> (ChE 356) (*ChE 310) 3	<b>ChE 310</b> (ChE 210) (Engr 160) 3	<b>ChE 302</b> (Jr. classif.) 1	16
	S	<b>Comm Elec</b> 3	<b>SSH Elec</b> 3	<b>Chem Elec</b> 3	<b>ChE 382</b> (ChE 310) (ChE 381) (*ChE 357) 3	<b>ChE 358</b> (ChE 310) (ChE 357) 3	<b>ChE 325</b> (ChE 357) (*ChE 381) 2		17

<b>Year 4</b>	F	<b>SSH Elec</b> 3	<b>SSH Elec</b> 3	<b>Engr Elec</b> 3	<b>Prof Elec</b> 3	<b>ChE 421</b> (Math 267) (*ChE 358) (*ChE 382) 3		15
	S	<b>SSH Elec</b> 3		<b>ChE Elec</b> 3	<b>Prof Elec</b> 3	<b>ChE 430</b> (ChE 358) (ChE 382) 4	<b>ChE 426</b> (ChE 325) (ChE 358) (ChE 382) 2	15

## Undergraduate Degree Planning

The purpose of planning your ChE degree is to allow you to determine what courses/programs/activities will help you meet your goals in a timely manner.

On the flowchart (previous page), cross off courses that you already have completed and circle the courses in which you are currently enrolled. Complete the Plan of Study (POS) form on the facing page by following the steps below:

1. Completely fill out the heading.
2. List credits that can be used to meet degree requirements earned before entering ISU (transfer, AP, testout, etc.) in the first Semester block. Label this semester as “TR” for transfer.
3. List any transfer course that needed to be evaluated in the “Approved Course Substitutions” with the ISU course number that it was evaluated as being ‘equivalent to’ or as a ‘substitute for’.
4. The next Semester block would be your first term at ISU. Label it appropriately (e.g., “F06” for Fall 2006; “S07” for Spring 2007; or either “SS07” or “1’07” for Summer 2007). List all courses taken that term. Do this for each term through the current term.
5. Continue listing courses that you plan to take for future terms, checking off each course on your flowchart as you list it on the POS form. This will help you to account for each requirement without listing the requirement more than once.
6. List each elective course on the right column under the requirement that it will meet. Do this as you list the course in the term that you will take the course.
7. Keep in mind/make sure
  - A. Courses are available during the term that you have scheduled them,
  - B. Credit loads for each semester are within acceptable limits ( $\leq 18$  credits per semester, or  $\leq 21$  for Honors Program),
  - C. All course prerequisites are satisfied,
  - D. All curriculum requirements for graduation are satisfied.
8. Discuss your POS with your faculty advisor. Changes made to the Technical Elective choices are to be approved by your faculty advisor.
9. Those students who have submitted to the Student Services Office a completed POS with your faculty advisor’s signature may pick up registration materials in the Student Services Office, 2162 Sweeney. Students who have not submitted the signed POS will receive registration materials from their faculty advisor.

**CHEMICAL ENGINEERING CURRICULUM PLAN of Study** (2005-07, 2007-09, or 2009-10 – circle one)

Name \_\_\_\_\_ ID# \_\_\_\_\_ Entry Term \_\_\_\_\_ Today's Date \_\_\_\_\_

Honors \_\_\_\_\_ Double Degree w/ \_\_\_\_\_ Double Major w/ \_\_\_\_\_ Minor in \_\_\_\_\_ Grad Term \_\_\_\_\_

**USE PENCIL!!!!!!**

1. Fill out the heading completely.
2. Using the correct curriculum flow chart...
  - A. Cross out courses on the chart you have completed (ISU, Transfer, Test out, AP).
  - B. Circle the courses you are CURRENTLY taking on the chart.
3. Complete your POS **legibly**: Start with *applicable* transfer courses, fill in the courses prior to ISU, have taken, currently taking, and plan to take. Label terms as TR (transfer, AP, CLEP); F08; S09; 1'09 (summer), etc.
 

Make sure:

  - A. Courses are available in the term that you schedule them (e.g., ChE 392 is summer-only).
  - B. Credit loads each semester are within acceptable limits ( $\leq 18$  credits per semester).
  - C. All course prerequisites are satisfied.
  - D. All curriculum requirements for graduation are satisfied.

**APPROVED COURSE SUBSTITUTIONS**

_____ for _____	_____ for _____	_____ for _____
_____ for _____	_____ for _____	_____ for _____
_____ for _____	_____ for _____	_____ for _____

SEMESTER _____	CR _____	SEMESTER _____	CR _____	SEMESTER _____	CR _____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
<b>Total</b> _____		<b>Total</b> _____		<b>Total</b> _____	

SEMESTER _____	CR _____	SEMESTER _____	CR _____	SEMESTER _____	CR _____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
<b>Total</b> _____		<b>Total</b> _____		<b>Total</b> _____	

SEMESTER _____	CR _____	SEMESTER _____	CR _____	SEMESTER _____	CR _____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
<b>Total</b> _____		<b>Total</b> _____		<b>Total</b> _____	

SEMESTER _____	CR _____	SEMESTER _____	CR _____	SEMESTER _____	CR _____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
<b>Total</b> _____		<b>Total</b> _____		<b>Total</b> _____	

**ELECTIVES**

**SSH**

INT'L PERSPECTIVE (3 CR)  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr

US DIVERSITY (3 CR)  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr

SINGLE DEPT. (6-9 CR)  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr

OTHER SSH COURSES  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (15 Cr)

**TECHNICAL**

COMMUNICATION  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (3 Cr)

ADVANCED CHEMISTRY  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (3 Cr)

STATISTICS  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (3 Cr)

CHEMICAL ENGINEERING  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (3 Cr)

ENGINEERING  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (3 Cr)

PROFESSIONAL  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 \_\_\_\_\_ Cr  
 Total \_\_\_\_\_ (6 Cr)

ChE 392 is the 4-cr. Unit Ops lab that subs for ChE325/426 held each June in Oviedo, Spain

ADVISOR NOTES/STUDENT OBJECTIVE:

**Faculty Advisor**

# Policies

## Transfer Credits

1. By departmental policy, transfer grades of D+ or lower are not accepted for curriculum requirements.
2. 65 credits from a 2-year school are the maximum allowed to be applied to degree requirements.
3. The last 32 credits of the degree program must be at ISU. Exceptions may be granted in special cases. See your advisor.
4. Transfer students with transfer credits in chemical engineering core courses must earn at least 15 semester credits in ISU courses in this category at the 300-level or above to qualify for the B.S. degree in chemical engineering.

## English Proficiency Requirement

Beyond the completion of the freshman composition courses, English 150 and 250, certification of English proficiency is the responsibility of the student's major department. In Chemical Engineering, certification is accomplished by successful completion of the Communications elective (English 309, English 312, English 314, or Journalism and Mass Communications 347).

Students whose first language is not English must pass an English proficiency examination before taking English 150. A student not passing the exam must enroll each semester in a special English program until the minimum standards are met. This English program is designed to improve English skills resulting in increased success in coursework.

## Diversity/International Perspectives

All ISU students must complete a diversity requirement of 3 credits and an international perspectives requirement of 3 credits. Consult the lists shown on pages 10 through 13 for courses that are also on the accepted SSH course list and <http://www.iastate.edu/~registrar/courses/div-ip-guide.html> for a more complete list of courses that will meet either the US Diversity or International Perspective requirements.

## Graduation Requirements

You will receive a copy of your Advisement/Degree Audit form each semester at the time of registration. You should check each semester to ensure that each course taken or transferred is properly applied to the correct curricular category. Ask your advisor or advising coordinator to make corrections so that the Advisement/Degree Audit form will be correct by the semester preceding your expected semester of graduation. Students will need to fill out an Application for Graduation at the same time as registering for the term they plan to graduate. Applications are available online at <http://www.iastate.edu/~registrar/forms/gradapp.pdf>. The applications will be accepted during the registration period for the graduation term. Degree audits will be printed during the first week of classes for students who submit the application by the week before the first day of the semester they plan on graduating. Late submissions result in delayed printing.

## Pass-Not Pass Policy

A maximum of nine Pass-Not Pass semester credits may be used to meet graduation requirements. Courses offered on a Satisfactory-Fail basis may not be taken on a Pass-Not Pass basis. If you pass a course taken under the Pass-Not Pass system, you may not repeat the course on a graded basis.

Pass-Not Pass credits can be applied toward requirements for a B.S. degree in chemical engineering only if the course is specified in the curriculum as a social science and humanities elective or is a course not used in the degree program. Pass-Not Pass credits are not acceptable for technical elective courses or for courses used to satisfy the US diversity or international perspectives requirements.

## Part 3: Opportunities for Undergraduates



## International Studies in Chemical & Biological Engineering

The department of CBE has established one of the most active international study programs at Iowa State University. These programs have been recognized as being one of the leading internationalization efforts for American chemical engineering departments. Through these programs you have the opportunity to:

- ◆ study for 1-2 semesters at prominent chemical engineering departments in Europe, Asia, or Australia;
- ◆ participate in 5-6 week summer school course in Oviedo, Spain;
- ◆ gain international work experience with a global corporation in conjunction with an academic exchange.

A summary of the programs available to chemical engineers is provided below. You are urged to contact the Program Coordinators for more information. Several of the programs have application due dates that you should carefully note.

### International Summer Study Program

The Chemical Engineering Department has a summer study program in Oviedo, Spain available to juniors, seniors, and qualified sophomores involving a chemical engineering laboratory course.

#### University of Oviedo Summer Laboratory Program

This five-week program offers the opportunity to complete a lecture and laboratory course at the University of Oviedo and to compare the technical and cultural aspects of the U.S. and Spain. There is also ample opportunity to travel in Europe for those deciding to do so. Students from University of Wisconsin also participate in the Oviedo program.

Iowa State students who participate in this program earn 7 semester credits in ChE 391 and 392, which apply toward the B.S. requirements at ISU (4 credits substitute for ChE 325 & 426 and 3 credits may apply to the SSH requirement). The credits are given on the basis of participating in the following:

1. An orientation course during spring semester at ISU.
2. Lectures attended and laboratory experiments performed during a five-week program at the University of Oviedo.
3. Visits to Spanish chemical engineering departments, research laboratories, and manufacturing facilities, mostly during the third week of the program.

The cost of the program (excluding personal entertainment and transportation costs) is about \$7,000 for Oviedo. Loans and foreign study grants are available to qualified applicants.

Applications for these programs are due in the fall, usually by mid-November.

For further information, contact the instructors  
Kenneth Jolls, 2155 Sweeney or J. C. Hill, 3155 Sweeney.

## International University Exchanges

The ISU Chemical Engineering Department administers a number of highly successful university exchanges with international universities. The mutual exchange agreements involve several of the leading chemical engineering departments in Europe, Australia, and Asia. Students generally attend for one to two semesters, perhaps with a travel period coordinated with the university schedules. Course work is sufficiently similar at these universities so that students are able to continue their degree program at ISU without interruption. The exchanges allow students to develop a better cultural and social understanding of the host country and to participate more fully in a new academic experience. Most students have formed lasting contacts with classmates and faculty.

The programs are organized according to ISU procedures established through the ISU Study Abroad Center. This includes:

- ◆ applying for the program at specific dates (see each program below)
- ◆ registering and paying tuition and fees as if remaining at ISU, but selecting course work at the international university
- ◆ paying no fees at the international university, but providing your own transportation and living costs
- ◆ receiving credit for the courses towards your degree

Specific arrangements for each program differ slightly; contact the program coordinator for each exchange.

Please visit the Engineering International Programs & Services Website, <http://www.eng.iastate.edu/intlprogs>, or contact them at [eip@iastate.edu](mailto:eip@iastate.edu) for general questions about study abroad and the application process.

### National University of Singapore

The National University of Singapore consists of nearly 23,000 students studying in the disciplines of engineering, science, business administration, architecture and building, arts and social sciences, dentistry, law, and medicine. NUS has been recognized as one of the premier universities in southeast Asia. Excellent laboratory, equipment, and library facilities are to be found on this spectacular urban campus in modern Singapore. All classroom instruction is in English.

For further information, contact Professor Kurt Hebert, 2037 Sweeney Hall or  
Professor Say-Kee Ong, 486 Town Engineering Hall.  
You should start your plans 6-8 months before your planned departure to Singapore.  
The application deadline is October 1 for spring semester and March 1 for fall semester.

### Monterrey Tec

The Tecnológico de Monterrey (Monterrey Tec) is the premier undergraduate engineering institute in Mexico, covering nearly all engineering disciplines. It was the first in Mexico and one of the first outside the U.S. to be accredited by the Accreditation Board for Engineering and Technology. The Tec campus is located within a bus ride of the center of Monterrey, Mexico's third largest city. Just above it are the first ranges of the Sierra Maestre Oriental.

A working knowledge of Spanish is required, as most courses at Monterrey Tec are taught in it.

For general information, contact Peter Reilly, 2031 Sweeney Hall,  
Or Nancy T. Guthrie, Study Abroad Center, 256 Memorial Union.

### **University College London – Chemical and Biochemical Engineering**

An exchange program for chemical engineering juniors has been established with the Chemical Engineering. The program is for the complete academic year with two different sets of courses to be taken depending on whether you want traditional chemical engineering or a biochemical engineering emphasis.

For further information, contact Professor Charles Glatz, 2162 Sweeney Hall.  
Plan to apply to UCL in early spring for the following year.

### **University of Limerick, Ireland**

The campus, located on the banks of the River Shannon, lies at the heart of the 600-acre National Technological Park, three miles outside the city of Limerick. The university currently houses a population of some 9,000 students.

For further information, contact Professor Frank Peters, 2019 Black Engineering.  
You should start your plans 6-8 months before your planned departure to Ireland.  
The application deadline is October 1 for spring semester and March 1 for fall semester.

### **Swiss Federal Institute of Technology — Lausanne**

ISU has had an exchange program with the Swiss Federal Institute of Technology (EPFL) in Lausanne since 1984. Students exchange on a one-for-one basis. ISU students pay tuition to ISU and room & board in Lausanne. The exchange is for a full year, and roughly 30 cr. toward graduation should be earned by a student taking a full course load.

EPFL is a world-class engineering and science university. It covers all engineering disciplines found at ISU except agricultural and industrial engineering. In addition, it offers physics, chemistry, and mathematics. Courses are taught in French. Humanities and language courses can be taken at the adjacent University of Lausanne.

EPFL offers scholarships of Sfr. 4500 (approximately \$3500 at the current exchange rate) to ISU engineering students.

The requirements for participation are a GPA of 3.0, junior standing at time of leaving, and three years of university-level French (those with less can take intensive French during the preceding summer in Switzerland).

For further information, contact Peter J. Reilly, 2031 Sweeney Hall.  
The application deadline for the following fall and spring is February 15.

## **Bogaziçi University (BU) & Middle East Technical University (METU) — Turkey**

Bogaziçi University and Middle East Technical University are clearly two of the most prestigious universities in Turkey. Bogazici University was founded as the first American higher education institution outside the US as Robert College. Bogaziçi offers extensive coursework taught in English. It has most of the engineering programs including Chemical Engineering. Located only five minutes from the Bosphorus Strait, the university is in the heart of Istanbul. For more information about the university, see their website at <http://www.boun.edu.tr>

Middle East Technical University was founded in 1956 with academic and administrative assistance from USA. METU offers extensive coursework taught in English. The Engineering College offers 14 degree programs including Chemical Engineering (with three of their faculty being graduates of ISU) and the engineering undergraduate enrollment is significantly larger than at ISU. Located in the outskirts of capitol city of Ankara in a beautiful campus, it provides an excellent setting for student both academic and extracurricular activities. For more information about the university, see their web site at <http://www.metu.edu.tr/>. For more information about Turkey, see the PowerPoint presentation on the Embassy of Turkey to the U.S. website at <http://www.turkey.org>.

Students who are interested in applying for the BU or METU exchange program must be full-time engineering students at ISU and have an overall 3.0 GPA. No knowledge of Turkish is needed for the exchange program, but students are encouraged to learn some conversational Turkish prior to departure.

Applications include the application form, an unofficial transcript from ISU, two letters of reference, and a 250-word statement of purpose. Applications should be completed by early October.

Dr. C. Glatz, 2162 Sweeney, is the Ch E contact. Contact Dr. M. Akinc, 2220 Hoover Hall, for the details of living and studying in Turkey. Applications should be completed by early October.

## **Other International Opportunities**

Additional programs that offer opportunities for chemical engineering students to study or work abroad are handled by the college's Engineering International Programs office and ISU's Study Abroad Office. More information is available by visiting the following websites:

- ◆ Engineering International Program: <http://www.eng.iastate.edu/intlprogs/>
- ◆ Study Abroad Center: <http://www.studyabroad.iastate.edu/>

## Honors Program

Students with high ability and clear educational objectives are encouraged to investigate the opportunities offered by the University Honors Program. The Honors Program emphasizes the development of individualized programs of study to meet the needs of students who have demonstrated the ability and maturity to assume more than the usual degree of responsibility for their education. The Honors Program also offers the opportunity to take Honors courses and Honors seminars, to make arrangements to take almost any course for Honors credit, and to carry out individual projects of an original, scholarly nature. Graduation as a member of the Honors Program is noted on the student's diploma, permanent record, and in the commencement program.

An undergraduate student who has a cumulative grade point average of 3.35 or greater may apply for the program during the second semester of residence or thereafter. A student must participate for a minimum of 48 credit hours. Students with somewhat lower grade points may be admitted providing they appear to have unusual potential or have demonstrated outstanding scholastic ability in other ways.

More information about the program can be obtained from E. W. Cochran, 1035 Sweeney; C.E. Glatz, 2114 Sweeney; J. C. Hill, 3155 Sweeney; P. J. Reilly, 2031 Sweeney; B. H. Shanks, 2119 Sweeney; R.D. Vigil, 3037 Sweeney; or S.K. Mallapragada, 3035 Sweeney; who serve as advisors to chemical engineering students in the program.

Information can also be obtained from the Honors Program Office in the Jischke Honors Building and from students currently participating in the program.

## Undergraduate Research Program and Independent Study

Students may participate in a special undergraduate research program or may pursue independent study through ChE 499 or ChE 490, respectively. These opportunities may be particularly valuable for students planning to obtain an advanced degree or for students desiring work in a specific industry.

Students considering future research studies (such as graduate school) or employment in industrial or academic research may participate in a special undergraduate research program by registering for ChE 499. **At least 3 credits/semester** are required, and students are strongly encouraged to participate for 2 semesters. These credits can be applied to the degree program as **technical electives (6 credits maximum)**. Students will participate in special meetings covering topics such as: the methodology of conducting scientific research, the status of the research in industry and academia, ethics and scientific professionalism, safety, general opportunities for graduate research in chemical engineering, application procedures for graduate school, availability of national fellowships, and specific research opportunities at Iowa State. A faculty coordinator will arrange these general meetings. Students will select research projects by consultation with faculty members (collaborative projects are encouraged) and will attend group meetings on a regular basis. Students will be encouraged to attend the graduate research seminar (ChE 601) also. Upon completion of the research project, a written report will be submitted to the faculty coordinator. A poster display and presentation will be scheduled, and the superior achievement in ChE 499 will be determined by a panel of faculty and students. Outstanding performance in ChE 499 will also be recognized by participation in regional student chapter meetings and other events.

Students may also participate in a special topics project involving independent study by registering for ChE 490. These projects may include literature studies/reviews, completion of the AIChE Student Design Contest Problem, setting up a laboratory experiment, etc. Students may receive a **maximum of 3 credits that can be applied to the technical electives requirement**. Students will select these projects by consultation with individual faculty members. A written report and an oral presentation will be required at the conclusion of the project. Participation in regional student chapter meetings is also anticipated for outstanding contributions.

Honors program students may participate in either option by registering for ChE 490H.

More information about participation in ChE 499 can be obtained from Dr. R. D. Vigil, 3037 Sweeney Hall.

## Faculty and Their Research Interests

Students should contact faculty members directly if they are interested in working for them.

**R. C. Brown** - The use of biorenewable resources (crops and biomass) as a source of chemicals and energy is the focus of our research activities. Combustion and gasification in fluidized bed for electric power production is one aspect of our work. In collaboration with fermentation experts, we are also evaluating a hybrid thermal/biological process to convert lingo-cellulose into alcohols and acids.

**A. R. Clapp** - We are interested in colloidal and interfacial phenomena, particularly at the nanoscale. We are pursuing synthesis, characterization, and applications of quantum dot nanocrystals as novel fluorescent materials for biological investigations. The unique behavior of colloidal quantum dots is due quantum confinement charge carriers leading to tunable spectral properties. We are also interested in small-scale force measurements (sub-pN) with optical tweezers which employ focused light to non-invasively manipulate colloidal particles in solution. These unique tools have the potential to reveal behavior of biological systems previously inaccessible to experimentalists. This work has direct implications in such diverse areas as cell proliferation, particle filtration, pathogenesis, biomaterial design, and biosensing.

**E. W. Cochran** - My research group combines the principles of thermodynamics with polymer chemistry to design new polymeric materials that possess advanced characteristics currently unavailable from the modern commodity plastics industry. The common theme in the various types of systems we work with is using the thermodynamics of phase separation to create highly ordered structures with feature sizes from 10-100 nm (a nanometer is 1 billionth of a meter). The applications in which we are interested vary from flame resistant materials, to highly elastic materials, to high performance fuel cell membranes, to liquid crystal display technologies, or even controlled drug delivery.

**R. O. Fox** - Computation and modeling of turbulent reacting flows, computational fluid dynamics applied to the chemical process industry, applied mathematics with emphasis on stochastic processes, and high-end computing and visualization applications in engineering.

**C. E. Glatz** - Bioprocessing is the common thread running through our research. Most of these projects focus on separations problems and most are collaborative efforts with life scientists. Our current projects include: (1) aqueous extraction of oil from soy as a means of eliminating solvent use and subsequent recovery of the protein components of the extract, (2) the use of plants as hosts for production of recombinant proteins for industrial and pharmaceutical uses, and (3) using proteomics to develop strategies for protein purification.

**K. R. Hebert** - Many materials used in structures and devices are intrinsically reactive with their environments and depend on thin surface film, formed by oxidation, for protection against degradation by corrosion. When corrosion does initiate on oxide-covered metals, it is typically confined to certain sites where the corrosion rate is very high. The goal of our research is to develop a fundamental understanding of critical chemical and physical processes involved in localized corrosion so that it can be effectively controlled.

**J. C. Hill** - We are studying problems of turbulent transport and mixing using statistical turbulence theory and direct numerical simulations. With the latter, all details of the three-dimensional, unsteady fluid motion are resolved. This work is coupled with laboratory experiments using modern laser diagnostic techniques (PIV and PLIF) to validate computational fluid dynamics (CFD) procedures.

**A. C. Hillier** - My research group performs exploratory experimental studies that encompass topics from chemistry, materials science, catalysis, electrochemistry and interfacial engineering. Our activities focus on combinatorial experimental systems, fuel cell catalysts, responsive polymer membranes, synthesis and characterization of new materials, and the application of in-situ imaging techniques for characterization of the structure and chemistry of solid-liquid interfaces.

**L. R. Jarboe** - Our research is focused on the engineering of biological systems. This includes modifying biological systems to do something useful, such as produce biorenewable compounds or locate the site of an infection, or increasing our understanding of how these biological systems work so that we can protect public health.

**K. R. Jolls** - Visualizing computer-based analyses through high-performance graphics holds great promise for chemical engineering research, practice, and teaching. Visual thinking utilizes powerful intellectual pathways that have traditionally been underused by scientists and engineers. Many branches of chemical engineering analysis possess visualizable components - concepts dealing with structures, stresses, fields, and phases. Computer simulation in such areas yields results that are often more readily interpreted visually - through static or dynamic views of carefully conceived structures.

**M. H. Lamm** - We use molecular simulation to discover and interpret fundamental relationships between molecular structure and thermodynamic properties in advanced materials used in applications such as pharmaceuticals, electronic and optical devices, environmentally responsive coatings, membrane separations, and energy storage.

**S. K. Mallapragada** - An understanding of transport mechanisms in polymeric systems is utilized in both traditional chemical engineering applications such as solvent removal, as well as biomedical applications such as drug delivery and tissue engineering.

**B. Narasimhan** - Nanoscale manipulation of polymer surfaces/interfaces, engineered biomaterials, controlled drug/protein/vaccine delivery, combinatorial materials science.

**J. M. O'Donnell** - Our research uses the controlled polymerization mechanism of reversible addition-fragmentation chain transfer (RAFT) to design polymer molecules with novel architectures and to produce polymer particle morphologies that are thermodynamically unfavorable when produced by standard methods. Our goals are to (1) develop a fundamental understanding of the relationships between molecular architecture, phase behavior, and microstructure in solutions of low molecular weight amphiphilic polymers, (2) develop polymer electrolyte membranes with bicontinuous microstructures for lithium ion batteries, and (3) refine the RAFT microemulsion polymerization mechanism to produce core-shell nanoparticles for applications such as drug encapsulation and nanosensors.

**P. J. Reilly** - We use molecular mechanics, molecular dynamics, and quantum mechanics to learn more about enzyme structure and function; construct large databases of enzyme amino acid sequences; produce, purify, and crystallize enzymes so that their three-dimensional structures and kinetic properties can be determined; and use liquid and gas chromatography and mass spectroscopy to identify and quantify components of agricultural and food processing residues.

**D. K. Rollins** - Our research is in an area that has been termed statistical process control (SPC). It has been defined broadly as "the use of statistical methods to improve process performance." The main thrust of our SPC research has been aimed at improving the quality of measured plant data. This area is called gross error detection (GED). The second emphasis involves reducing high dimensional data sets to low dimensional, easily interpretable, summary statistics. This research is critical because chemical process data are highly dimensional and often very difficult to interpret. The third item involves improving automatic process control by modeling both statistically and physically. Finally, our work has also involved linear and nonlinear stochastic modeling that is important to chemical engineering.

**I. C. Schneider** - Our research group is interested in understanding fundamental cellular behavior that drives the progression of disease states. This cellular behavior includes cell migration, cell adhesion, and cell-cell communication. We use an array of quantitative biochemistry and microscopy techniques to measure force transmission, protein-protein binding, and protein activation in and around living cells. These measurements can be made over time at subcellular resolution to understand how molecular processes drive cellular behavior. The eventual goal is to use these quantitative experimental observations to guide the development of multiscale mathematical models that might aid in the design of therapeutics for, or diagnosis of, pathologies such as cancer metastasis.

**B. H. Shanks** - Our group works on the design and synthesis of heterogeneous catalyst systems for efficient chemical reactions. Reaction systems that are of particular interest are conversions of biorenewable chemicals and fuels, which can be used to replace nonrenewable fossil fuel-derived chemicals and fuels. We are evaluating the ability to have sufficiently controlled synthesis of the catalytic reaction domain at the nanoscale so as to have molecularly well-defined active sites.

**J. V. Shanks** - Our research group specializes in metabolic engineering of plant secondary metabolites and in phytoremediation of explosives. Much of metabolic engineering work has focused on the production of indole alkaloids (secondary metabolites with high pharmaceutical value) in *Catharanthus roseus* hairy root tissue cultures. Our research program has developed quantitative tools (NMR, HPLC, etc.) and methodology in determining the sources of flux limitation in indole alkaloid production. We use the same plant tissue culture system, *C. roseus* hairy roots, as a model system for plant roots in our phytoremediation studies. Explosives are widespread and persistent in our environment, and plants may be one way to remediate contaminated soil and water. Our research group is determining the metabolic structure and kinetics of the transformation products of trinitrotoluene (TNT) and related nitroaromatic contaminants in plant tissues.

**R. D. Vigil** - We are studying heterogeneous reacting systems including 1) multiphase reacting Taylor-Couette flow, 2) reactive precipitation, and 3) triphase catalysis.

**T. D. Wheelock** - Current research is focused on the development of a combined catalyst and sorbent material for use in steam reforming methane to produce hydrogen while simultaneously capturing the byproduct carbon dioxide for disposal in an environmentally acceptable way. This material may also find application in the production of hydrogen from biomass and the simultaneous capture and disposal of the accompanying carbon dioxide.

## American Institute of Chemical Engineers (AIChE)

The professional society for chemical engineering is the American Institute of Chemical Engineers (AIChE). Iowa State University has a very active student chapter, which has gained national recognition through recent awards for its program and leadership and through awards won in student paper contests at regional meetings. More than one third of the undergraduates in chemical engineering are members of the student chapter.

The objectives of the chapter are to promote the professional development of its members and to contribute to the development of chemical engineering at Iowa State. Membership provides the opportunity to meet other chemical engineering students and the members of the faculty, to learn about the professional experiences of others, and to discuss employment and career possibilities. Senior students receive a free subscription to Chemical Engineering Progress, the national AIChE publication, and automatically become national members of AIChE upon graduation. Student members may attend meetings of the Iowa Section of AIChE where the cost of the meal is partially subsidized by the section. Student members may purchase Perry's Handbook at a discount through the student chapter.

Meetings will normally be held in the evening at Sweeney Hall. Meeting notices are placed on the bulletin board near the east door of Sweeney Hall and in classrooms. The initial evening meeting will be a guest speaker from the placement office. Other activities include attending the regional AIChE conference. The Chemical Engineering Department banquet is usually scheduled for sometime in April.

The best time to sign up for membership will be at the fall picnic. Membership dues are \$10 per year. If you have any questions about the student chapter, feel free to contact any of the officers listed below. We are looking forward to seeing you at the meetings. The chapter Website is at <http://aiche.cbe.iastate.edu/>.

### 2009-10 Officers

President	Elliot Combs	Treasurer	Samantha Chalfant
Vice President	Matt Vander Werff	Social	To be elected in the fall
Secretary	Matt Orum	Webmaster	To be elected in the fall
ChE Car Chair	Doug Vandermyde	ESC Rep	
Senior Rep		Junior Rep	
Soph Rep	To be elected in the fall	Freshman Rep	To be elected in the fall
Corporate Relations	Matthew Smolen	Publicity	
Faculty Advisors	A. R. Clapp		K. R. Jolls

## National Organization of Black Chemists and Chemical Engineers (NOBCChE)

NOBCChE offers diverse programs designed to foster professional development and encourage students to pursue careers in science and technical fields. Also, to provide industrial chemical companies with an avenue for better selection of prospective applicants.

### 2009-10 Officers

President	Alexis Hoffman	Secretary	Natasha Brohier
Treasurer	Kristina Lord	Fundraising	Vania Romay
Advisors	Derrick Rollins – Ch E		Malika Jeffries-El – Chem

## Omega Chi Epsilon

Omega Chi Epsilon, Chemical Engineering Honor Society, recognizes and promotes high scholarship, original investigation, and professional service in chemical engineering. The honor society was formed at the University of Illinois in 1931. The Beta Chapter was formed at Iowa State in 1932 and went inactive in 1937; the local chapter was reactivated in 1966. The current membership includes over 20,000 men and women from 67 chapters.

To be considered for membership, juniors must have a minimum GPA of 3.25 and seniors a minimum GPA of 3.0. Eligible students must also have completed six hours of chemical engineering courses. In addition, members must possess those traits of personality and leadership that make them most likely to succeed in their chosen fields. Initiation ceremonies are held during fall semester. The chapter organizes a number of service activities throughout the year, including: student-faculty FACs, the department's spring picnic, providing student representatives for departmental committees, and sponsoring the Omega Chi Epsilon Outstanding Senior Award given at the Chemical and Biological Engineering banquet.

### 2008-09 Officers

President	Waddah Moghram	Treasurer	Jenae Baumert
Vice President	Daniel Erickson	Social	Alison Dirks
Membership	Martin Garcia	Advisor	Laura Jarboe

For further information, please contact Dr. Laura Jarboe, 3051 Sweeney Hall.

### Other Honor Societies

There are a number of other honor societies available to chemical engineering students in addition to Omega Chi Epsilon. Some of them are listed below. Unless otherwise stated, membership is university-wide and available to undergraduates.

Society	Restrictions	Qualities Recognized
Alpha Lambda Delta	Freshmen	Scholarship
Cardinal Key	Seniors	Leadership, service, scholarship
Mortar Board	Juniors	Scholarship, leadership, service
Phi Eta Sigma	Freshmen	Scholarship
Phi Kappa Phi	All-University	Scholarship
Tau Beta Pi	Engineering College	Scholarship, character

### Employment & Scholarship Opportunities

Each year the College of Engineering, through its Scholarships and Awards Committee, makes awards to engineering students. Last year, over 1000 students in the college received awards. These awards are donated by various companies, trade associations, and individuals. The awards vary in value. The average award this past year was \$1,845. More information is available online at <http://www.eng.iastate.edu/scholarships/>. These awards are based primarily on academic performance and university involvement. Scholarships based on financial need are handled by the university Student Financial Aid Office, 0210 Beardshear or <http://www.financialaid.iastate.edu/>.

To be considered for a College of Engineering Scholarship, the applicant must have attended Iowa State University for a period of one semester prior to spring semester and must have at least two semesters remaining in which to use the award starting in the fall semester. The number of scholarships available for freshmen is limited so the majority of the awards are made for use during the student's junior or senior years. **Applications must be made on the Web and are normally due by February 1<sup>st</sup>.**

For additional information, see Professor D. Rollins or Christi Patterson (2162 Sweeney).

## Loans

Students interested in obtaining an education loan should contact the Office of Student Financial Aid, Room 0210 Beardshear Hall. Information about the requirements and arrangements for taking out a loan are best handled directly with personnel from this office.

## Part-Time Employment

In addition to jobs available to students throughout the university, there are a number of part-time jobs available in CBE. These are of two general types: research helpers and student assistants.

## Research Helpers

The Chemical Engineering faculty employs undergraduate research helpers during the summer, fall, and spring for projects. Ames Laboratory also employs some summer research assistants. Normally these positions require a person with at least sophomore standing. The work is widely varied since the primary function of the research helper is assisting graduate students with their projects. Typical functions include performing chemical analysis, constructing equipment, taking data, and data reduction. Through this type of work, the student has an opportunity to gain valuable professional experience using modern equipment and research techniques.

## Student Assistants

The Chemical Engineering Department employs eight to ten students per semester as student assistants to serve primarily as paper graders. Normally the student must be a junior or senior. Aside from providing income, this work gives the assistant a valuable review of basic chemical engineering gained through following the solutions and errors of others.

Interested students should apply during the first two days of the semester  
in the Student Services Office, 2162 Sweeney

## Cooperative (Work-School) Program

The Chemical Engineering Department conducts a cooperative program with a number of chemical processing companies. The program provides an opportunity for students enrolled in chemical engineering to gain practical experience while working toward their Bachelor's degrees. Co-op work arrangements are with companies located throughout the US, but the majority are in Iowa and Minnesota.

The five-year program calls for alternate semesters of school and work experience primarily during the sophomore and junior years. Offers of employment are made by the participating companies after interviews with the students. Students need to register with Engineering Career Services, 308 Marston Hall, to schedule interviews.

Advantages of the program are that students:

1. Increase competitive edge for full-time employment,
2. Enhance career exploration and clarification of professional goals,
3. Develop greater responsibility and self-confidence,
4. Improve interpersonal and communication skills,
5. Create a process of development, assessment, and continuous professional growth,
6. Maintain full time student status without tuition and fees
7. Work experience reflected on transcript
8. Can earn much of their college expenses, and
9. Compliment classroom learning with practical work experience.

Disadvantages include:

1. Loss of continuity in some course sequences because of the periodic interruption of work,
2. Possible limitations in participating in some outside activities, and
3. Lengthening of program.

During the year, meetings to describe the co-op program will be sponsored by Engineering Career Services and some companies. Interviews for co-op positions will be scheduled with the participating companies in both the fall and spring semesters. Interested students who have the necessary qualifications should discuss this with their advisor. The co-op advisor, Professor Brent Shanks, 2119 Sweeney Hall, is also available if you have questions or concerns. The process is explained fully on the Engineering Career Service's Website (<http://www.engineering.iastate.edu/ecs/home.html>). The Student Services Office staff can assist with necessary paperwork.

The following is a listing of some of the companies who currently take chemical engineering co-ops from Iowa State University: 3M, Caterpillar, Dow Corning, Equistar, Fisher Rosemount, General Mills, IBM, Intel, and Procter & Gamble.

### **Internships**

During the freshman and sophomore years, intern opportunities in industry are limited so the best employment opportunity for students is normally in their local community. After the sophomore year, more internships become available for either fall or spring terms. Information is posted in the Engineering Career Services' webpage (<http://www.engineering.iastate.edu/ecs/home.html>). The Fall and Spring Career Fairs are excellent opportunities to pursue job opportunities. The Student Services Office staff can assist with necessary paperwork.

An industrial work experience is an excellent opportunity for students to observe first-hand the type of positions held by chemical engineers. Some students return to their employer for permanent employment after graduation; however, neither the employer nor employee is under any obligation to extend the work experience to permanent employment.

There are many opportunities for summer work with various governmental agencies, both state and federal. Since many of these agencies do not recruit on campus, Engineering Career Services maintains an up-to-date file of opportunities on the ECS Website.

The experience gained in the application of the principles studied in the classroom is noticeable to the student and will make subsequent course work more meaningful.

### **Process for Relevant Work Experiences**

1. Students need to print out and complete the Employment Acceptance Form found on this Website: <http://www.engineering.iastate.edu/ecs/internships.html>
2. Have either the student's advisor or Brenda Kutz, Student Services Office in 2162 Sweeney, sign the form.
3. The form is then returned to Engineering Career Services. The student will be provided the appropriate course reference number.

Be sure to look at the Check List that is also linked off of the above Webpage because it will provide all of the deadlines, forms, and information that you need to know and complete to earn an "S" for the work experience.



## *Part 4: Preparing for the Future*



## Permanent Employment

By your last year, you should have some career objective in mind. Study the list of interviewers that will be provided to seniors by Engineering Career Services (ECS) on the Web at <http://www.eng.iastate.edu/ecs/> when school begins in the fall. Select from it those companies that you feel most closely meet your career objectives. Your next step is to learn as much about these companies as you can. Use *Thomas' Register*, *Moody's Financial Index*, and available company literature (on file in the Reading Room, 3149 Sweeney Hall and on the shelves at the ECS Office in Room 308 Marston Hall).

Do not overlook state and federal agencies when seeking permanent employment. The various pollution control and environmental protection agencies offer unique opportunities for chemical engineering graduates.

Early in the fall semester, ECS offers seminars on the interviewing process. Take full advantage of the services offered by this office; they are experts in the placement process. Students need to register online with ECS to gain full access to the services. Feel free to discuss with them interviewing problems that you may encounter. Get all the help you can in selling yourself to the interviewer. Start interviewing as soon as possible in the fall. You will gain confidence with experience.

Insofar as possible, arrange interview trips to miss as few classes as possible. Of course, you are expected to inform your instructors of travel plans before you leave and to make up all assignments. Many of your interviews can be scheduled between semesters.

When you seek employment, it is common practice for prospective employers to ask you for faculty references. It is expected that you will contact the faculty member before you give his or her name as a reference. Make sure that the references you choose know something about you. Take along a copy of your resume. Questions typically found on reference requests include the following:

- ◆ Does the student finish assignments on time?
- ◆ Do the assignments show evidence of extra thought or effort?
- ◆ How does the student react to criticism?
- ◆ What is the student's attitude towards safety practices?

## Graduate Study in Chemical & Biological Engineering

Chemical Engineering students frequently discover that there is much to be learned about chemical engineering beyond what is taught in the undergraduate courses. Part of the purpose of graduate study (M.S. and Ph.D.) is to further develop the fundamental theories presented at the undergraduate level; many ISU students pursue graduate work for this reason.

An equally important purpose is to give the student an opportunity to plan, undertake, analyze, and report on an independent research project. Graduate study may also qualify the student for employment opportunities which require more technical knowledge and research experience than has been acquired at the undergraduate level.

A very comprehensive resource for students thinking about going to graduate school is available at <http://www.gradschools.com/>. This website has information about various schools and about the Graduate Record Examination (GRE) along with other valuable information. A different website that has more detailed information specifically about chemical engineering graduate programs in the country is maintained by the Council for Chemical Research at <http://www.ccrhq.org/CCRNET/guide-graduate-education-chemical-engineering>. Students interested in pursuing graduate studies in Biomedical Engineering should refer to <http://www.whitaker.org/>.

Students thinking about pursuing graduate studies should try to become involved in undergraduate research. At ISU, they can register for research credits through ChE 490, ChE 499, or ChE 490H. Up to 6 credits can be used towards their professional or ChE elective requirements. Summer research opportunities are also available at ISU. Students interested in pursuing summer research opportunities at other schools should visit <http://www.nsf.gov/home/crssprgm/reu/start.htm> for a list of the National Science Foundation Research Experience for Undergraduates sites.

Research and teaching assistantships or fellowships are widely available to qualified students for graduate study in chemical engineering. Typical PhD stipends at ISU provide more than \$1800 per month in addition to tuition. There are also several competitive fellowships such as the National Science Foundation, the Tau Beta Pi, and other graduate fellowships for which students may apply.

Application forms for admission to graduate study at Iowa State are available at <http://www.grad-college.iastate.edu/>. The application deadlines are Feb 1 for the fall semester and October 1 for the spring semester. A list of current research areas of the CBE faculty at Iowa State is also available on the CBE website at <http://www.cbe.iastate.edu/research.html>.

## Preparation for Non-Engineering Graduate Study

Chemical engineering graduates are looked upon very favorably by medical, law, and business schools. Some planning is required to insure that you have taken the courses required by admissions committees for those programs. In addition to reading the information given below, students interested in law or medicine should visit with LAS Pre-professional advisors in Catt Hall (<http://www.las.iastate.edu/academics/prehealth/> or <http://www.las.iastate.edu/academics/prelaw/index.shtml>). Students interested in a MBA should visit with the Business Graduate Program Office in the Gerdin Business Building (<http://www.bus.iastate.edu/MBA/>).

### Medical School

General requirements (in addition to the normal Chemical Engineering requirements) include:

Organic Chemistry Laboratory - Chem 333L, 334L. 1 cr. each, and  
Principles of Biology - Biol 211 (3), 211L (1), 212 (3), and 212L (1).

One 300-level biology course, e.g., Biol 313 (3), Biol 314 (3), Biol 351 (5), Biol 352 (4), Biol 353 (4), or Biol 335 (4) is required by the University of Iowa College of Medicine.

Some of these courses may be used to satisfy the professional elective requirements. Additional relevant courses that would apply to the professional elective requirement are the biologically-related chemical engineering courses such as ChE 415, 427, 440, or 562.

Note that you may need to begin taking these courses earlier in your program than as the Professional Electives are indicated on our flow chart.

### Business School (MBA)

Most MBA programs are set up to take students coming from non-business programs and have no specific requirements. However, such courses as Econ 101 and 102, which fulfill Social Science/Humanities elective requirements, and a course in statistics, which may count as a Professional Elective, are highly recommended. Courses in accounting, management, or finance would provide a head start and can be taken as extra electives, which would not count towards a Chemical Engineering degree.

### Law School

Law schools generally have no specific course requirements, but do look for courses where the student would have had writing and speaking experience, particularly where the topic required critical appraisal of material. Such courses often may be used as Social Science/Humanities electives. For example, students have found that Phil 206, Introduction to Logic and Scientific Reasoning, is helpful in preparing for the Law School Admissions Test.