

IOWA STATE UNIVERSITY

Helping you become your best.

Department
of
Chemical and Biological
Engineering

Undergraduate Booklet

2013-2014 Catalog
Revised May 2013

cheme-advising@iastate.edu

<http://www.cbe.iastate.edu/academics/guides-and-handbooks/>

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Important Deadlines & Dates 2013-2014

| | <u>Fall 2013</u> | <u>Spring 2014</u> |
|---|------------------|--------------------|
| Classes Start (call instructor if you miss first day) | 8/26 | 1/14 |
| Undergraduate graduation applications AccessPlus (or paper form available in Registrar's Office, 210 Enrollment Services) due | 5/31/13 | 11/22/13 |
| Fee Payment Due | 8/20 | 1/20 |
| University holiday, offices closed, classes not in session | 9/2 | 1/20 |
| Second half-semester courses begin (Midterm) | 10/1 | 3/10 |
| Web Registration (for the next term) Start (Make an appointment to see your advisor) | 10/25 | 3/26 |
| Schedule Changes (Forms in 2162 Sweeney) | | |
| Last day through AccessPlus | 8/30 | 1/17 |
| Last day without fee | 8/30 | 1/17 |
| Last day to drop without appearing on permanent record or counting toward total course drop limits | 8/30 | 1/17 |
| Last day to change a course from audit to credit | 8/30 | 1/17 |
| Last day to change from Pass-Not Pass to grade basis without counting toward total Pass-Not Pass allowance | 9/9 | 1/27 |
| Last day to elect to audit a course – instructor must approve | 9/9 | 1/27 |
| Last day to drop without extenuating circumstances | 11/1 | 3/28 |
| Last day to indicate a non-automatic designated repeat | 11/1 | 3/28 |
| Last day to change to or from Pass/Not Pass basis. Course will count toward the total P/NP credits allowed. | 11/1 | 3/28 |
| Break | 11/25-29 | 3/17-21 |
| Final Exams (schedule on web from beginning of semester) http://www.registrar.iastate.edu/exams/ | 12/16-20 | 5/5-5/9 |

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://catalog.iastate.edu/>
- ◆ Schedule of Classes
<http://classes.iastate.edu/>
- ◆ ISU Information Handbook (academic regulations)
<http://policy.iastate.edu/>
- ◆ ISU Academic Calendar
<http://www.registrar.iastate.edu/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.registrar.iastate.edu/forms/>
- ◆ Student Answer Center
<http://financialaid.iastate.edu/sac/>
- ◆ Course Equivalency Guide
<http://www.admissions.iastate.edu/equiv/index.php>
- ◆ Experimental (###X) Course Descriptions
<http://www.registrar.iastate.edu/faculty-staff/courses/explisting>
- ◆ College of Engineering
<http://www.engineering.iastate.edu/>
- ◆ Premed Information
<http://www.las.iastate.edu/pre-health/>
- ◆ Pre-Law Information
<http://www.las.iastate.edu/pre-law/>
- ◆ Scholarship Information
<http://www.financialaid.iastate.edu/>
<http://www.engineering.iastate.edu/student-services/scholarships/>
<http://www.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.registrar.iastate.edu/fees/>
- ◆ Weather
<http://www.iastate.edu/weather/?/>
- ◆ Writing Center
<http://new.dso.iastate.edu/wmc>
- ◆ *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

Home What's New Sitemap Search About Us Help www.aiche.org

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

Chemical & Biological Engineering Facilities

Sweeney Hall (which is open from 7 a.m. to 12 midnight daily 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 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.

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 Room

A room (1153 Sweeney) has 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 beforehand. The Reading Room, 3149 Sweeney, has been converted to a laptop computer lab that is available when not in use by a class.

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 1123 and 1150 are open to all ChE students, but are primarily utilized by undergraduates. These rooms are reserved for classes several hours during the week. Other labs across campus also 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 (schlage@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 marstontech@iastate.edu.

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 DeAnn Pitman in the Student Services Office, 2162 Sweeney, or set your info release preferences in AccessPlus.

Advising

The initial point of contact for most advising issues will be your academic advisor. The academic advising staff will help you with routine matters such as degree audit corrections, answering policy/procedure questions, handling scheduling difficulties, and guiding you to campus resources. Students will also see their academic advisor for registration advising (registration deadlines are given at the beginning of the booklet) and to pick up registration materials. Shortly after enrolling in ChE 202, students will be assigned to a faculty mentor. When meeting with your academic advisor that semester, you will receive a Plan of Study (POS) form, which you should attempt to complete before meeting with your faculty mentor. Students should visit with their faculty mentor to discuss progress and goals, select electives that support their program of study, generate career goals, learn more about the profession of chemical engineering, for assistance 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 14) will be introduced during registration in the semester the student is enrolled in ChE 202. This will allow for time to complete the form and meet their faculty mentor before the next term. Degree Audits (DA) show students' progress towards completing degree requirements and are available in AccessPlus at any time to the student or advisor.

Students will receive their current RAN sheet from:

- ◇ Their academic advisor, or
- ◇ The Student Services Office.

Students on Academic Warning (AW) or Probation (AP) must see their advisor to discuss their options and Academic Self-Assessment form (completed online in AccessPlus) by the 10th day of class. Students on AP or AW must meet with their advisor for their registration RAN sheet. Students will meet with their faculty or academic advisor for their RAN sheet during the registration period prior to their graduation term.

Your faculty mentor 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
Consulting on course adds/drops

The ChE Academic Advising Staff 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
Consulting on course adds/drops

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

| | |
|----------------------------|---|
| Tornado Watch | Conditions are favorable for tornadoes (or severe thunderstorms) to occur. Stay informed. |
| Tornado Warning | A tornado or severe thunderstorm is occurring or is imminent. Seek shelter immediately. |
| Severe Thunderstorm | A storm that produces wind damage, dime-size hail or larger and winds up to 58 mph. |
| Tornado | A violently rotating column of air in contact with the ground and coming from a thunderstorm. |
| Funnel cloud | 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 engineering Basic Program (BP) with a grade point average of 2.00 or better (transfer credits are included in this average). The basic program courses are:

| | |
|--------------------------------|------------------------|
| Mathematics 165, 166 | Chemistry 177 (or 167) |
| English 150, 250 | Physics 221 |
| Engineering 101, 160 (ChE 160) | Library 160 |

Students are to complete the BP prior to enrolling in 200-level engineering courses; however, Engl 150 and 250 may be taken concurrently. These and other exceptions are listed under the College of Engineering Curricula in the ISU Catalog (<http://catalog.iastate.edu/collegeofengineering/>).

For transfer students, enrollment is permitted for no more than two semesters prior to satisfying the basic program requirements. For transfer students, certain waivers and substitutions are possible and should be discussed with your 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.
3. English Placement info: <http://www.agstudent.iastate.edu/orientation/english%20placement%20info.htm>.

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: 202, 210, 310, 325, 356, 357, 358, 381, 382, 420, 421, 426, and 430. The Degree Audit available in AccessPlus will show this grade point average each semester under Chemical Engineering Core. Transfer credits will be included in this average. The cumulative GPA is based upon all courses, excluding transfer courses. This means the grade point average will be based upon those courses that were actually taken at Iowa State University.

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, a significant emphasis on the design process is in each of the chemical engineering laboratory courses. Students will design at least one new experiment in each of these courses. 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.registrar.iastate.edu/courses/div-ip-guide.html>).** *Note that some departments offer courses where most are acceptable for SSH requirements. A notation of "All courses except..." are acceptable is under these department headings. For these departments, the list of courses in this handbook include only those courses that also meet US Diversity or International Perspectives requirements, but other courses from this department may apply to the SSH requirements.*

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 completing a course to fulfill the International Perspectives requirement; however, the requirement of completing a minimum of 15 credits from the SSH list still must be met.

Applying Independent Study (490) courses for the Social Science and Humanities Electives will require **prior** approval by your advisor and Curriculum Committee. 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 |
|------------------------|----------|--------|-------------|
| A M D (T C) | | | |
| | 165 | X | |
| | 257 | | |
| | 354 | | X |
| | 356 | | |
| | 362 | | X |
| | 372 | | X |
| | 467 | | |
| Acct | | | |
| | 215 | | |
| AE SHM | | | |
| | 342 | X | |
| | 379 | X | |
| | 421 | | X |
| Af Am | | | |
| All courses except 490 | | | |
| | 201 | X | |
| | 325^ | | X |
| | 330 | X | |
| | 334 | X | |
| | 347 | X | |
| | 350 | X | |
| | 353 | X | |
| | 354 | X | |
| | 460 | X | |
| Agron | | | |
| | 342 | | X |
| Am In | | | |
| All courses except 490 | | | |
| | 210 | X | |
| | 240 | X | |
| | 310 | X | |
| | 315 | X | |
| | 320 | X | |
| | 322 | X | |
| | 323 | | X |
| | 328 | X | |
| | 342 | X | |
| | 346 | X | |
| | 426 | X | |
| Anthr | | | |
| | 201 | | X |
| | 202 | | |
| | 220 | | X |
| | 230 | | X |
| | 306 | | X |
| | 307 | | |
| | 308 | | |
| | 309 | | X |
| | 313 | | X |
| | 315 | X | |
| | 320 | X | |
| | 321 | | |
| | 322 | X | |
| | 323 | | X |
| | 325^ | | X |
| | 326^ | | X |
| | 332 | X | |
| | 335^ | | X |
| | 336 | | X |
| | 337^ | | X |
| | 340 | | X |
| | 411 | | X |

| Dept | Course # | US Div | Int'l Persp |
|------------------------------|----------|--------|-------------|
| Anthr cont. | | | |
| | 412^ | | |
| | 414^ | | |
| | 418 | | X |
| | 420^ | | |
| | 432^ | | |
| | 436^ | | X |
| | 439^ | | X |
| | 444 | | X |
| | 450 | | |
| Arch | | | |
| | 221 | | X |
| | 222 | | X |
| | 271 | | |
| | 321 | X | |
| | 420 | X | |
| | 422 | | X |
| | 423 | | X |
| | 424 | | |
| | 425 | | |
| | 426 | X | |
| | 427 | | X |
| ArtGr | | | |
| | 388 | X | |
| Art H | | | |
| All courses except 490 | | | |
| | 280 | | X |
| | 281 | | X |
| | 292 | X | |
| | 380^ | | X |
| | 381^ | | X |
| | 382 | | X |
| | 384 | | X |
| | 394^ | | X |
| | 395 | X | |
| | 481 | | X |
| | 494 | X | |
| Biol | | | |
| | 173 | | |
| | 307 | X | |
| Ch E | | | |
| | 391 | | X |
| CI St | | | |
| All courses except 480 & 490 | | | |
| | 273 | | X |
| | 275 | | X |
| | 353 | | X |
| | 372 | | X |
| | 373 | | X |
| | 374 | | X |
| | 376 | | X |
| | 394 | | X |
| Com Dis | | | |
| | 286 | X | |
| ComSt | | | |
| | 310 | | X |
| | 323 | X | |

| Dept | Course # | US Div | Int'l Persp |
|--------------|----------|--------|-------------|
| C R P | | | |
| | 253 | | |
| | 270 | X | |
| | 291 | | X |
| | 293 | | |
| | 376 | | |
| | 417 | | |
| | 484 | | |
| | 491 | | |
| CJ St | | | |
| | 240 | | |
| | 241 | | |
| | 320 | | |
| | 332 | | |
| | 340 | | |
| | 341 | | |
| | 351 | | |
| | 352 | | |
| | 402 | | |
| | 403 | | |
| Dance | | | |
| | 270 | | |
| | 360 | | |
| Dsn S | | | |
| | 181 | | |
| | 183 | | |
| | 221 | | X |
| | 222 | | X |
| | 270^ | X | |
| | 274 | X | |
| | 280 | | X |
| | 281 | | X |
| | 291 | | X |
| | 292 | X | |
| | 293 | | |
| | 321 | X | |
| | 371 | | |
| | 373 | | X |
| | 382 | | X |
| | 383 | | |
| | 385 | | |
| | 395 | X | |
| | 396 | | |
| | 417 | | |
| | 481 | | X |
| | 484 | | |
| | 487 | | |
| | 488^ | | |
| | 489 | | |
| | 491 | | |
| | 494 | X | |
| | 495^ | X | |
| | 496^ | | |
| | 498 | | |
| Econ | | | |
| | 101 | | |
| | 102 | | |
| | 301 | | |
| | 302 | | |
| | 312 | | |
| | 320 | | |
| | 321 | X | |
| | 344 | | |

| Dept | Course # | US Div | Int'l Persp |
|----------------------------|----------|--------|-------------|
| Econ cont. | | | |
| | 353 | | |
| | 355 | | X |
| | 362 | | |
| | 370 | | X |
| | 376 | | |
| | 378 | X | |
| | 380 | | |
| | 385 | | X |
| | 415^ | | |
| | 455 | | X |
| | 480 | | |
| Engr | | | |
| | 320 | | X |
| | 327 | | |
| Engl | | | |
| | 201 | | |
| | 205^ | | |
| | 219 | | |
| | 225 | | |
| | 226 | | |
| | 227 | | |
| | 228 | | |
| | 237 | | |
| | 240 | X | |
| | 260 | | |
| | 301^ | | |
| | 330 | | |
| 335 - 396 inclusive | | | |
| | 340 | 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 | | |
| | 445 | | |
| | 450 | | |
| | 451^ | | |
| | 452^ | | |
| | 460 | | |

| Dept | Course # | US Div | Int'l Persp |
|------------------------------|----------|--------|-------------|
| Env S | | | |
| 160 | | | |
| 173 | | | |
| 201 | | | |
| 220 | | | X |
| 293 | | | |
| 320 | | | |
| 334 | | | |
| 342 | | | X |
| 345 | | | X |
| 355 | | | |
| 380 | | | |
| 382 | | | |
| 383 | | | |
| 384 | | | X |
| 442 | | | |
| 450 | | | X |
| 460 | | | |
| 472 | | | |
| 482^ | | | |
| 484 | | | |
| 491 | | | |
| FS HN | | | |
| 342 | | | X |
| Geog^ | | | |
| 100^ | | | X |
| 324^ | | | X |
| 325^ | | | X |
| 327^ | | | X |
| Geron | | | |
| 373 | | | |
| 377 | | X | |
| 378 | | X | |
| Hist | | | |
| All courses except 490 & 495 | | | |
| 201 | | | X |
| 202 | | | X |
| 207 | | | X |
| 240 | | X | |
| 245^ | | | X |
| 280 | | | X |
| 281 | | | X |
| 284 | | | X |
| 323 | | | X |
| 336 | | | X |
| 337 | | | X |
| 338 | | | X |
| 339 | | | X |
| 341 | | | X |
| 345^ | | X | |
| 353 | | X | |
| 354 | | X | |
| 371^ | | | X |
| 374 | | | X |
| 376^ | | | X |
| 380 | | X | |
| 383 | | | X |
| 386 | | X | |
| 389 | | | X |
| 390 | | | X |
| 421 | | | X |
| 422 | | | X |
| 424^ | | | X |
| 425^ | | | X |

| Dept | Course # | US Div | Int'l Persp |
|-------------------|----------|--------|-------------|
| Hist cont. | | | |
| 443^ | | | X |
| 473 | | X | |
| 475^ | | | X |
| HD FS | | | |
| 102 | | | |
| 227 | | | |
| 239 | | X | |
| 240 | | X | |
| 249 | | X | |
| 270 | | | |
| 276 | | X | |
| 349^ | | X | |
| 367 | | | |
| 373 | | | |
| 377 | | X | |
| 378 | | X | |
| 448^ | | X | |
| 479 | | | |
| 488^ | | | |
| H Sci | | | |
| 150 | | X | |
| IE | | | |
| 325X^ | | X | |
| Int St | | | |
| 235 | | | X |
| 430 | | | X |
| Jl MC | | | |
| 101 | | | |
| 401 | | | |
| 460 | | | |
| 461 | | | |
| 462 | | | |
| 464 | | | |
| 474 | | | X |
| 476 | | | X |
| 477 | | X | |
| L A | | | |
| 272 | | X | |
| 274 | | X | |
| 285^ | | | |
| 371 | | | |
| 373 | | | X |
| LAS | | | |
| 150^ | | X | |
| 160^ | | X | |
| 161^ | | X | |
| 211 | | X | |
| 222^ | | X | |
| 250^ | | | X |
| 322 | | X | |
| 325 | | X | |
| 328X | | X | |
| 333^ | | | |
| 385 | | | X |
| 488^ | | | |

| Dept | Course # | US Div | Int'l Persp |
|-----------------------------------|----------|--------|-------------|
| Ling | | | |
| 119 | | | X |
| 219 | | | |
| 286 | | X | |
| 305 | | | |
| 309 | | | X |
| 413 | | | |
| 420 | | | |
| 422 | | X | |
| 463 | | | X |
| Mgmt | | | |
| 370 | | | |
| 371 | | | |
| 414 | | | |
| 419 | | | |
| 471 | | | |
| 472 | | X | |
| Mat E | | | |
| 220 | | | X |
| 391 | | X | |
| Math | | | |
| 489^ | | | X |
| M E | | | |
| 220 | | | X |
| 280^ | | | |
| 281^ | | | |
| 284^ | | | |
| 285^ | | | |
| 484 | | | X |
| 488^ | | | |
| 489^ | | | |
| Music | | | |
| 102 | | | X |
| 302 | | | |
| 304 | | X | |
| 383 | | | X |
| 384 | | | X |
| 471^ | | | X |
| 472 | | X | |
| 473 | | | |
| 475 | | | |
| 476 | | | |
| Phil | | | |
| All courses except 207 & 490 | | | |
| 235 | | X | |
| 338 | | X | |
| Pol S | | | |
| All courses except 301,475, & 490 | | | |
| 241 | | | X |
| 251 | | | X |
| 315 | | | X |
| 333X | | X | |
| 341^ | | | X |
| 345 | | | X |
| 347 | | | X |
| 349 | | | X |
| 350 | | | X |
| 354 | | | X |
| 383 | | | X |
| 385 | | X | |
| 452 | | | X |

| Dept | Course # | US Div | Int'l Persp |
|--|----------|--------|-------------|
| Psych | | | |
| 101 | | | |
| 230 | | | |
| 280 | | | |
| 313 | | | |
| 314 | | | |
| 346 | | X | |
| 347 | | X | |
| 348 | | | |
| 360 | | | |
| 380 | | | |
| 381 | | | |
| 383 | | | |
| 401 | | | |
| 413 | | | |
| 450 | | | |
| 460 | | | |
| 484 | | | |
| 488 | | | X |
| Relig | | | |
| All courses except 490 & 499 | | | |
| 105^ | | | X |
| 205 | | | X |
| 210 | | X | |
| 242 | | | X |
| 323 | | | X |
| 328 | | X | |
| 333 | | | X |
| 334 | | X | |
| 336 | | X | |
| 340 | | | X |
| 342 | | X | |
| 352 | | | X |
| 353^ | | | X |
| 355 | | | X |
| 356 | | | X |
| 358 | | | X |
| 376 | | | X |
| 384 | | | X |
| 453 | | | X |
| Soc | | | |
| All courses beyond 130 except 202, 302, 412, 460, 464, & 490 | | | |
| 220 | | | X |
| 235 | | X | |
| 327 | | X | |
| 328 | | X | |
| 330 | | X | |
| 331 | | X | |
| 332 | | X | |
| 345 | | | X |
| 411 | | | X |
| 431^ | | X | |
| Sp Cm | | | |
| 205 | | | |
| 212 | | | |
| 305 | | | |
| 312 | | | |
| 323 | | X | |
| 350 | | | |
| 417 | | | |

| Dept | Course # | US Div | Int'l Persp |
|---|------------|--------|-------------|
| T SC | | | |
| | 220 | | X |
| | 341 | | |
| | 342 | | X |
| | 343 | | |
| | 474 | | X |
| Thtre | | | |
| | 110 | | |
| | 465 | | |
| | 466 | | |
| U St | | | |
| | 160^ | X | |
| | 235^ | | X |
| | 290N/490N^ | X | |
| | 321 | X | |
| | 336^ | | |
| | 342^ | | X |
| W S | | | |
| All courses except 258, 490, 491, & 499 | | | |
| | 160 | X | |
| | 201 | X | |
| | 203 | X | |
| | 205 | X | |
| | 222 | X | |
| | 301 | | X |
| | 302 | X | |
| | 307 | X | |
| | 321 | X | |
| | 323 | X | |
| | 325 | | |
| | 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 | |
| | 385 | X | |
| | 386 | X | |
| | 422 | X | |
| | 444 | | |
| | 494 | X | |

| Dept | Course # | US Div | Int'l Persp |
|--|----------|--------|-------------|
| W LC | | | |
| 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 270 | | X |
| | WLC 278X | | X |
| | WLC 484 | | X |
| Arabc | | | |
| | 102 | | X |
| | 201 | | X |
| Chin | | | |
| | 102 | | X |
| | 201 | | X |
| | 202 | | X |
| | 272 | | X |
| | 301 | | X |
| | 302 | | X |
| | 304 | | X |
| | 370 | | X |
| | 375 | | X |
| Czech | | | |
| | 102 | | X |
| | 201 | | X |
| | 202 | | X |
| Frnch | | | |
| | 102 | | X |
| | 201 | | X |
| | 202 | | X |
| | 301 | | X |
| | 304 | | X |
| | 320 | | X |
| | 333^ | | X |
| | 334^ | | X |
| | 370 | | X |
| | 375^ | | X |
| | 378 | | X |
| | 395 | | X |
| | 440^ | | X |
| | 471^ | | X |
| | 472^ | | X |

| Dept | Course # | US Div | Int'l Persp |
|--------------|----------|--------|-------------|
| Ger | | | |
| | 102 | | X |
| | 201 | | X |
| | 202 | | X |
| | 301 | | X |
| | 304 | | X |
| | 305 | | X |
| | 320 | | X |
| | 330 | | X |
| | 370 | | X |
| | 371 | | X |
| | 375 | | X |
| | 378 | | X |
| | 395 | | X |
| | 475^ | | X |
| | 476 | | X |
| Greek | | | |
| | 102 | | X |
| | 201 | | X |
| | 332 | | X |
| | 441 | | X |
| | 442 | | X |
| Latin | | | |
| | 102 | | X |
| | 201 | | X |
| | 332 | | X |
| | 441 | | X |
| | 442 | | X |
| Polsh | | | |
| | 102^ | | X |
| | 201^ | | X |
| | 202^ | | X |
| Port | | | |
| | 102 | | X |
| | 112 | | X |
| | 201 | | X |
| | 370^ | | X |

| Dept | Course # | US Div | Int'l Persp |
|--------------|----------|--------|-------------|
| Rus | | | |
| | 102 | | X |
| | 201 | | X |
| | 202 | | X |
| | 301 | | X |
| | 304 | | X |
| | 314 | | X |
| | 320^ | | X |
| | 370 | | X |
| | 375 | | X |
| | 378 | | X |
| | 395 | | X |
| SerbC | | | |
| | 102^ | | X |
| Span | | | |
| | 102 | | X |
| | 195 | | X |
| | 201 | | X |
| | 202 | | X |
| | 295 | | X |
| | 301 | | X |
| | 303 | | X |
| | 304 | | X |
| | 314 | | X |
| | 321 | | X |
| | 322 | | X |
| | 323 | | X |
| | 324 | | X |
| | 326 | | X |
| | 330 | | X |
| | 331 | | X |
| | 332 | | X |
| | 333 | | X |
| | 351 | | X |
| | 352 | | X |
| | 354 | | X |
| | 370 | | X |
| | 395 | | X |
| | 440 | | X |
| | 401 | | X |
| | 441 | | X |
| | 445 | | X |
| | 463 | | X |

###^ – No longer offered at ISU.

###X – Experimental course; see <http://www.registrar.iastate.edu/catalog/exp/12-13/> for description & scheduled offering.

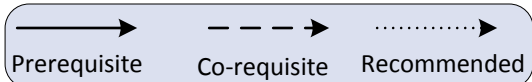
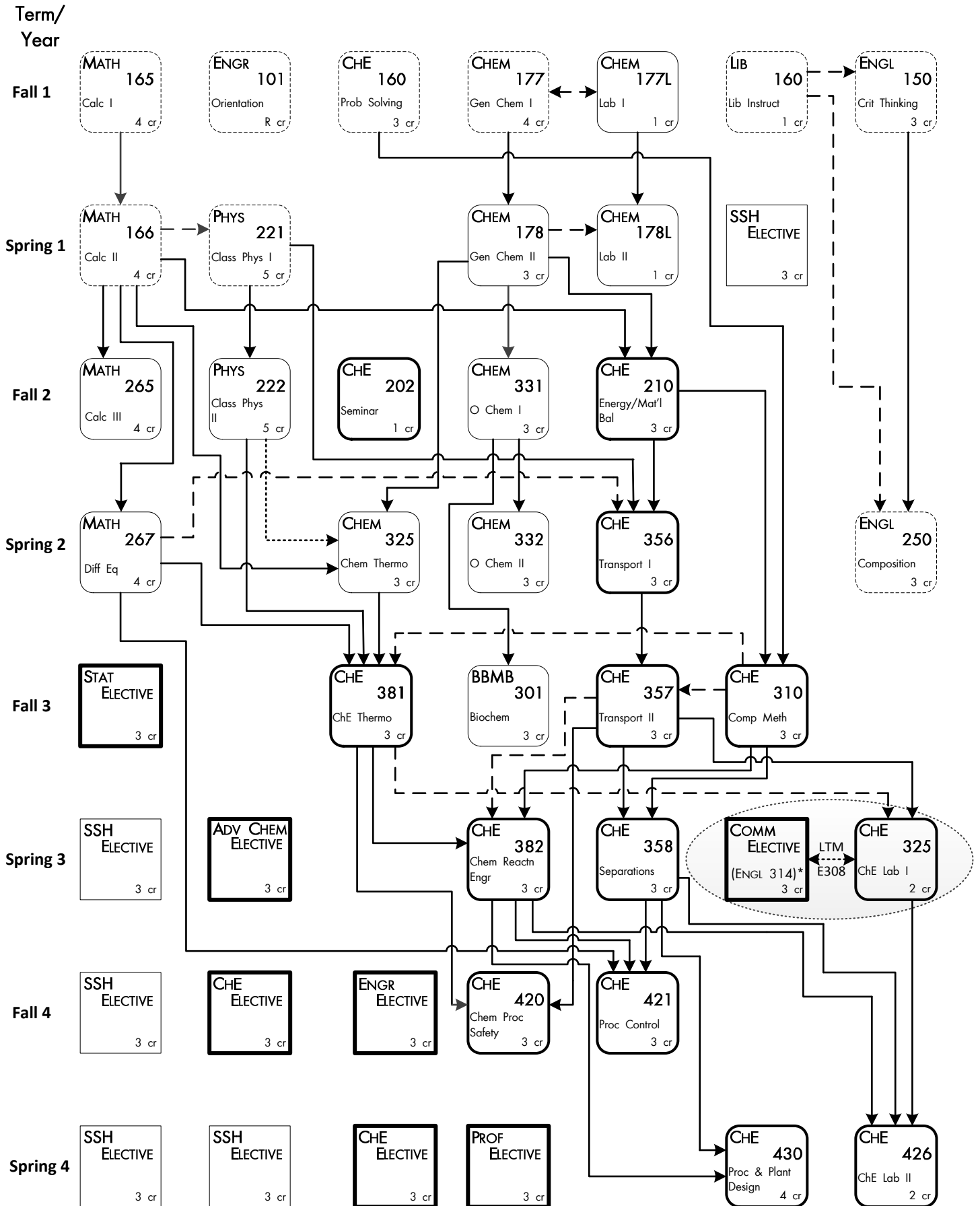
Undergraduate Degree Planning

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, test out, 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., "F10" for Fall 2010; "S11" for Spring 2011; or either "SS11" or "1'11" for Summer 2011). 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 (on page 15) 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 (≤ 18 credits per semester, or ≤ 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 mentor. Changes made to the Technical Elective choices are to be approved by your faculty mentor.
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.

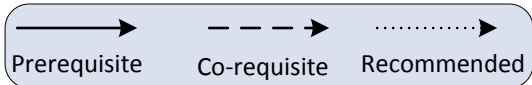
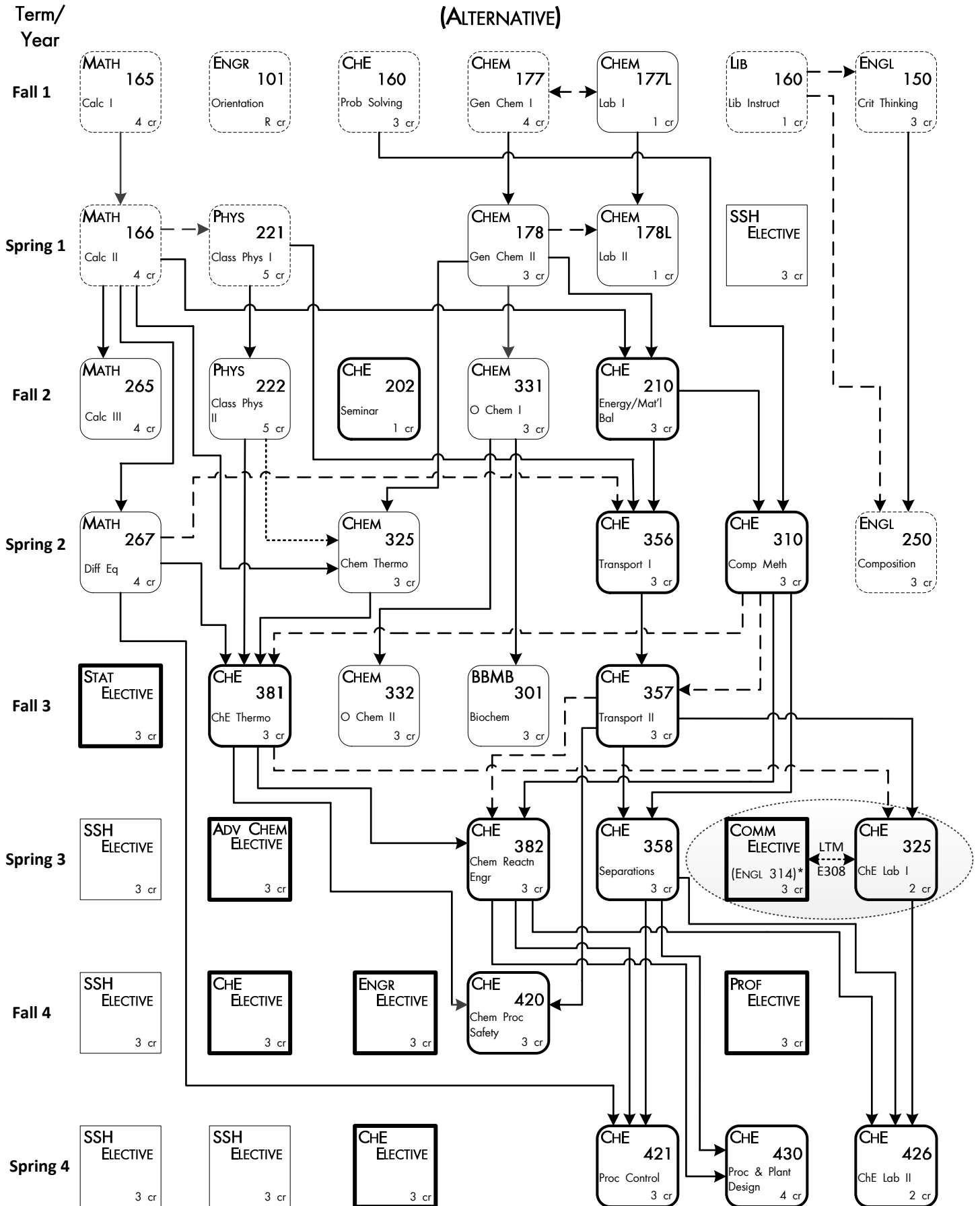
CHEMICAL ENGINEERING FLOWCHART, 2013-14 CATALOG (129 CREDITS)



* LTM E308 consists of taking specific sections of Engr 314 and ChE 325 together.

CHEMICAL ENGINEERING FLOWCHART, 2013-14 CATALOG (129 CREDITS)

(ALTERNATIVE)



* LTM E308 consists of taking specific sections of Engl 314 and ChE 325 together.

Undergraduate Curriculum in Chemical Engineering

2013-14 Catalog
Total Credits = 129

First Year (32)

Fall Semester (16)

| | | |
|---|-----------|-------------------------|
| 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 |
| 1 | +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 |
| 1 | * ChE 302 | Seminar |

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 (15)

| | | |
|---|-----------|---------------------------------|
| 3 | * ChE 310 | Computational Methods in ChE |
| 3 | * ChE 357 | Transport Phenomena II |
| 3 | * ChE 381 | ChE Thermodynamics |
| 3 | BBMB 301 | Biochemistry |
| 3 | | Statistics Elective |

Spring Semester (17)

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

Fourth Year (33)

Fall Semester (15)

| | | |
|---|-----------|-------------------------|
| 3 | * ChE 421 | Process Control |
| 3 | ChE 420 | Chemical Process Safety |
| 3 | | Engineering Elective |
| 3 | | ChE Elective |
| 3 | | SS&H Elective |

Spring Semester (18)

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

+ Basic Program – must earn a minimum GPA of 2.0 and must be completed before enrolling in the 1st 200-level Engr course. English may be taken concurrently.

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

☆ LTM E308 consists of taking specific sections of Engl 314 and ChE 325 together.

Undergraduate Curriculum in Chemical Engineering

2013-14 Catalog

Total Credits = 129

(prerequisites/*co-requisites)

| | | | | | | | | | |
|---------------|---|------------------------------------|---|---|----------------------|---------------------|----------------------|-------------------------------------|----|
| Year 1 | F | Math 165 4 | Chem 177 (*Chem 177L) 4 | Chem 177L (*Chem 177) 1 | Engl 150 3 | Lib 160 1 | Engr 160 3 | Engr 101 R | 16 |
| | S | Math 166 (Math 165) 4 | Chem 178 (Chem 177) (Chem 177L) 3 | Chem 178L (Chem 177L) (*Chem 178) 1 | SSH Elec 3 | | | Phys 221 (*Math 166) 5 | 16 |

| | | | | | | | | |
|---------------|---|--|------------------------------------|------------------------------------|--|---------------------|---|----|
| Year 2 | F | | Math 265 (Math 166) 4 | Chem 331 (Chem 178) 3 | ChE 210 (Chem 178) (Math 166) 3 | ChE 202 1 | Phys 222 (Phys 221) 5 | 16 |
| | S | Engl 250 (Engl 150) (*Lib 160) 3 | Math 267 (Math 166) 4 | Chem 332 (Chem 331) 3 | Chem 325 (Chem 178) (Math 166) 3 | | ChE 356 (ChE 210) (Phys 221) (*Math 267) 3 | 16 |

| | | | | | | | | |
|---------------|---|--|-----------------------|------------------------------------|---|--|--|-------------------------|
| Year 3 | F | | Stat Elec 3 | BBMB 301 (Chem 331) 3 | ChE 381 (Chem 325) (Math 267) (Phys 222) (*ChE 310) 3 | ChE 357 (ChE 356) (*ChE 310) 3 | ChE 310 (ChE 210) (Engr 160) 3 | 15 |
| | S | | SSH Elec 3 | Chem Elec 3 | ChE 382 (ChE 310) (ChE 381) (*ChE 357) 3 | ChE 358 (ChE 310) (ChE 357) 3 | ☆ ChE 325 (ChE 357) (*ChE 381) 2 | ☆ Comm Elec 3 |

| | | | | | | | | |
|---------------|---|----------------------|----------------------|-----------------------|----------------------|--|--|----|
| Year 4 | F | SSH Elec 3 | | Engr Elec 3 | ChE Elec 3 | ChE 421 (Math 267) (*ChE 358) (ChE 382) 3 | ChE 420 (ChE 357) (ChE 381) 3 | 15 |
| | S | SSH Elec 3 | SSH Elec 3 | Prof Elec 3 | ChE Elec 3 | ChE 430 (ChE 358) (ChE 382) 4 | ChE 426 (ChE 325) (ChE 358) (ChE 382) 2 | 18 |

☆ LTM E308 consists of taking specific sections of Engl 314 and ChE 325 together.

Undergraduate Curriculum in Chemical Engineering *Biological Engineering Option*

2013-14 Catalog
Total Credits = 129

First Year (31.5)

| Fall Semester (16) | | | Spring Semester (16) | | |
|---------------------------|-----------|-------------------------|-----------------------------|-----------|-----------------------|
| 4 | +Math 165 | Calculus I | 4 | +Math 166 | Calculus II |
| 3 | +Engl 150 | Crit. Think. & Comm. | 3 | Chem 178 | General Chemistry |
| 4 | +Chem 177 | General Chemistry | 1 | Chem 178L | General Chemistry Lab |
| 1 | Chem 177L | General Chemistry Lab | 5 | +Phys 221 | Intro. to Physics I |
| 3 | +Engr 160 | Engineering Problems | 3 | | SS&H Elective |
| R | +Engr 101 | Engineering Orientation | | | |
| 1 | +Lib 160 | Library | | | |

Second Year (31)

| Fall Semester (15) | | | Spring Semester (16) | | |
|---------------------------|-----------|------------------------|-----------------------------|-----------|-------------------------------|
| 3 | * ChE 210 | Material & Energy Bal. | 3 | * ChE 356 | Transport Phenomena I |
| 4 | Math 265 | Multivariable Calculus | 4 | Math 267 | Differential Equations |
| 5 | Phys 222 | Intro. to Physics II | 3 | Chem 332 | Organic Chemistry II |
| 3 | Chem 331 | Organic Chemistry I | 3 | Chem 325 | Chemical Thermodynamics |
| | | | 3 | +Engr 250 | Written/Oral/Vis/Elect. Comp. |

Third Year (33)

| Fall Semester (16) | | | Spring Semester (17) | | |
|---------------------------|-----------|---------------------------------|-----------------------------|-----------|-----------------------------------|
| 3 | * ChE 310 | Computational Methods in ChE | 3 | | Communication Elective } ☆ |
| 3 | * ChE 357 | Transport Phenomena II | 3 | * ChE 325 | ChE Laboratory I } ☆ |
| 3 | * ChE 381 | ChE Thermodynamics | 2 | * ChE 358 | Separations |
| 1 | * ChE 302 | Seminar | 3 | * ChE 382 | Chemical Reaction Engr |
| 3 | | Statistics Elective | 3 | | SS&H Elective |
| 3 | BBMB 301 | Biochemistry or | 3 | BBMB 420 | Physiological Chemistry or |
| | BBMB 404 | Biochemistry I or | | BBMB 405 | Biochemistry II or |
| | Biol 313 | Principles of Genetics | | Biol 314 | Molecular Cell Biology |

Fourth Year (30)

| Fall Semester (15) | | | Spring Semester (15) | | |
|---------------------------|-----------|-------------------------|-----------------------------|-----------|----------------------------|
| 3 | * ChE 421 | Process Control | 4 | * ChE 430 | Process and Plant Design |
| 3 | * ChE 420 | Chemical Process Safety | 2 | * ChE 427 | Biological Engr Laboratory |
| 3 | | Engineering Elective | 3 | | Professional Elective |
| 3 | | ChE Elective | 3 | | ChE Elective |
| 3 | | SS&H Elective | 3 | | SS&H Elective |
| | | | 3 | | SS&H Elective |

+ Basic Program – must earn a minimum GPA of 2.0 and must be completed before enrolling in the 1st 200-level Engr course. English may be taken concurrently.

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

☆ LTM E308 consists of taking specific sections of Engl 314 and ChE 325 together.

Undergraduate Curriculum in Chemical Engineering *Biological Engineering Option*

2013-14 Catalog
Total Credits = 129
(prerequisites/*co-requisites)

| | | | | | | | | | |
|---------------|---|------------------------------------|---|---|----------------------|---------------------|----------------------|-------------------------------------|----|
| Year 1 | F | Math 165 4 | Chem 177 (*Chem 177L) 4 | Chem 177L (*Chem 177) 1 | Engl 150 3 | Lib 160 1 | Engr 160 3 | Engr 101 R | 16 |
| | S | Math 166 (Math 165) 4 | Chem 178 (Chem 177) (Chem 177L) 3 | Chem 178L (Chem 177L) (*Chem 178) 1 | SSH Elec 3 | | | Phys 221 (*Math 166) 5 | 16 |

| | | | | | | | | |
|---------------|---|--|------------------------------------|------------------------------------|--|---------------------|---|----|
| Year 2 | F | | Math 265 (Math 166) 4 | Chem 331 (Chem 178) 3 | ChE 210 (Chem 178) (Math 166) 3 | ChE 202 1 | Phys 222 (Phys 221) 5 | 16 |
| | S | Engl 250 (Engl 150) (*Lib 160) 3 | Math 267 (Math 166) 4 | Chem 332 (Chem 331) 3 | Chem 325 (Chem 178) (Math 166) 3 | | ChE 356 (ChE 210) (Phys 221) (*Math 267) 3 | 16 |

| | | | | | | | | |
|---------------|---|--|-----------------------|---|---|--|---|----------------------------------|
| Year 3 | F | | Stat Elec 3 | 1-BBMB 404 (Chem 332) or 2-BBMB 301 (Chem 331) 3 | ChE 381 (Chem 325) (Math 267) (Phys 222) (*ChE 310) 3 | ChE 357 (ChE 356) (*ChE 310) 3 | ChE 310 (ChE 210) (Engr 160) 3 | 16 |
| | S | | SSH Elec 3 | Chem Elec 1-BBMB 405 (BBMB 404) or 2-BBMB 420 (Chem 332) (BBMB 301) 3 | ChE 382 (ChE 310) (ChE 381) (*ChE 357) 3 | ChE 358 (ChE 310) (ChE 357) 3 | ChE 325 (ChE 357) (*ChE 381) 2 ☆ | Comm Elec 3 ☆ 17 |

| | | | | | | | | |
|---------------|---|----------------------|----------------------|-----------------------|----------------------|---|--|----|
| Year 4 | F | SSH Elec 3 | | Engr Elec 3 | ChE Elec 3 | ChE 421 (Math 267) (*ChE 358) (ChE382) 3 | ChE 420 (ChE 357) (ChE381) 3 | 15 |
| | S | SSH Elec 3 | SSH Elec 3 | Prof Elec 3 | ChE Elec 3 | ChE 430 (ChE 358) (ChE 382) 4 | ChE 427 (ChE 325) (ChE 358) (ChE 382) 2 | 18 |

☆ LTM E308 consists of taking specific sections of Engl 314 and ChE 325 together.

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.

Students are strongly encouraged to take the **LTM E308** learning community that integrates the writing component of Engl 314 with the lab reports in ChE 325. Students in the linked sections have the advantage of extra help with their written reports and joint assignments that are submitted to both classes.

The chemical engineering curriculum includes 21 credits of technical electives, which provide students the opportunity to develop a deeper understanding of additional areas of science and engineering. Students are encouraged to carefully plan their elective choices. Elective planning **MUST** be done in consultation with your faculty mentor and the choices must be clearly identified on their Curriculum Plan of Study (POS), see [p. 14](#).

Technical electives can be selected to develop a breadth of knowledge or to establish an “area of emphasis.” For example, you may wish to take a broad range of courses to prepare for graduate school. Alternatively, you may wish to focus your studies to develop a stronger background in an area of emphasis, such as biochemical engineering or solid state materials processing. Suggestions for several additional areas of emphasis are listed on pages 23-25. Your faculty mentor can also assist you in preparing an emphasis not currently listed on those pages. Be sure to plan early enough to permit taking necessary prerequisites. **No more than 6 credits total of ChE 490 or other STEM departmental independent/research study may be counted towards technical electives.**

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

| | MINIMUM CREDITS |
|---|------------------------|
| Social Science & Humanities electives: (see pages 9-12) | 15 |
| Technical Electives | 21 |
| Communications electives: Engl 309, Engl 312, Engl 314, or JI MC 347 | 3 |
| Advanced Chemistry electives: Agron 320 BBMB 404, 405, 411, 420, 461 CE 420 or EnvSci 459 Chem 211, 211L, 301, 316, 316L, 321L, 322L, 324, 331L or 333L, 332L or 334L, 401L, 402 FSHN 311, 311L, 410 | 3 |
| Statistics electives: Stat 305, 231, 341, 342, 401, 495, 496, Mat E 316 | 3 |
| Chemical Engineering electives: These include ChE 406, 408, 415, 440, 442, 420X, and any other 300+ ChE course not specified as required in the curriculum. | 6 |
| Engineering electives: Any 300+ engineering course outside of chemical engineering that does not repeat material in required ChE courses nor on SSH list. Approved exceptions: AerE 261, CprE 281, EE 201, EM 274, & MatE 273 Consult mentor for approval. | 3 |
| Professional electives: 300+ Physical Science, Life Science, Engineering, Statistics, Mathematics, or Computer Science not on SSH list Approved exceptions: Micro 201, 201L, and those approved for Engineering & Advanced Chem electives. Consult mentor for approval. | 3 |

* Courses not allowed as Technical Elective due to content overlap with required ChE courses: AE/BSE 316, 402, 411; AerE 446, EM 378, MatE 311, ME 332, 335, 411, 421, 436, 475

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 in Table II below, students may replace BBMB 301 with BBMB 404 and BBMB 405. BBMB 405 can be used to meet Chemistry Elective. ChE 426 may be replaced with ChE 427.

Table II – Electives for Biological Engineering Option

| | MINIMUM CREDITS |
|--|------------------------|
| Social Science & Humanities electives: (see pages 9-12) | 15 |
| Technical Electives | 21 |
| Communications electives: Engl 309, Engl 312, Engl 314, or JI MC 347 | 3 |
| Advanced Chemistry electives: BBMB 405, 411, 420, 451 | 3 |
| Statistics electives: Stat 305, 231, 341, 342, 401, 495, 496, Mat E 316 | 3 |
| Chemical Engineering electives: ChE 415, 440, 542, 562 | 6 |
| Engineering electives: BioE (Approved), BRT 501, C E 421, BSE 480, A E 380, MSE 580 | 3 |
| Professional electives: ChE 415, 440, 542, 562, 490 OR one APPROVED course from: 300+ Life Science (Biol 314), Chem, FS HN, or BBMB (not BBMB 301) and not on SSH list | 3 |

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

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 mentor to choose an appropriate set of electives to suit their individual career goals.

General Graduate School Preparation

Chemistry/Professional Electives

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

ChE/Professional Electives

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

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

ChE 447 (3) Polymers and Polymer Engineering (ChE 382 and Chem 331 or MatE 351) – only ChE 447 or MatE 351 can be used to meet degree requirements

ChE 490 (variable) Research/Independent Study

ChE 545 (3) Analytical and Numerical Methods (ChE 358 and Math 267)

ChE 500-level courses

Engineering Elective

EE 201 (4) Electric Circuits

EM 274 (3) Statics of Engineering

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)

General Industrial Preparation

Advanced Chemistry Elective

Chem 211/211L (2/2) Quantitative and Environmental Analysis/Lab

Chem 301 (2) Inorganic Chemistry

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

Engineering/Professional Electives

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

EM 274 (3) Statics of Engineering

Biochemical Engineering

Chemistry/Professional Electives

BBMB 404 (3) Biochemistry I (Chem 332) (recommend to replace BBMB 301)

BBMB 405 (3) Biochemistry II (BBMB 404)

BBMB 420 (3) Physiological Chemistry (Chem 332, BBMB 301 or Biol 314) – Only credit from either BBMB 404&405 or BBMB 420, not both, may be applied to graduation

ChE/Professional Electives

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

ChE 562 (3) Bioseparations (ChE 357)

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, (3) Fundamentals of Biorenewable Resources (senior or graduate classification)

Biomedical Engineering

Chemistry/Professional Electives

BBMB 404 (3) Biochemistry I (Chem 332)

BBMB 405 (3) Biochemistry II (BBMB 404) (recommend BBMB 404 to replace BBMB 301)

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)

Engineering Elective

EE 201 (4) Electric Circuits

Professional Elective

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)

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

Biol 314 (3) Principles of Molecular Cell Biology (Biol 313)

Environmental Science and Engineering

Chemistry/Professional Electives

CE 420 (3) Environmental Engineering Chemistry (CE 326, Chem 177, Chem 178, Math 166)

ChE/Professional Electives

ChE 406 (3) Environmental Chemodynamics (ChE 381 and *ChE 358)

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

Engineering/Professional Electives

CE 326 (3) Principles of Environmental Engineering (Chem 178, Math 166, and *EM 378)

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

Food Engineering

Chemistry/Professional Electives

FSHN 311 (3) Food Chemistry (FS HN 203, TSM 115, Chem 331 & 331L, and *BBMB 301)

ChE/Professional Electives

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

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

Engineering/Professional Electives

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

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 440 (3) Biomedical Applications of Chemical Engineering (ChE 210, Math 266, Phys 222)

ChE 447 (3) Polymers and Polymer Engineering (ChE 382 and Chem 331 or MatE 351) – only ChE 447 or MatE 351 can be used to meet degree requirements

Chemistry/Professional Electives

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

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

Engineering Elective

Mat E 273 (3) Principles of Materials Science and Engineering (Chem 177, Math 165)

Professional Elective

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

* Credit or Enrollment in

BioEngineering Minor

This program is open to all undergraduate engineering students at Iowa State University. This minor will provide students with a foundation of core biology and engineering concepts relevant to further study in biomedical engineering. In addition, students will receive an introduction to the application of engineering principles to biomedical problems from a multidisciplinary perspective as well as the applications within the majors of the participating departments. Minor requirements are as follows:

A minimum of 16 credits meeting the 6 course requirements below; a minimum of 9 credits must not be applied towards other degree requirements; and a minimum of 6 credits must be taken at the 300-level or above.

Note: Most students will need to complete 18 credits to fulfill all of the requirements of this minor.

| | | |
|------------------------------|--|-----|
| BIOL 212 | Principles of Biology II | 3 |
| BIOE 220 | Introduction to Biomedical Engineering | 3 |
| BIOL 256 | Fundamentals of Human Physiology | 3 |
| INTRO ENGR ELEC ¹ | | 3 |
| ADV ENGR ELEC ² | | 3 |
| PROF ELEC ³ | | 1-3 |

¹ A second (Introductory) Engineering Course from a department other than that of your major and that is not duplicative of material in a course taken in your own department. The topic of the course should have ready application to later BME-related electives in that discipline (MATE 273, EM 274 or 324, CHE 210, EE 201, or 230, or other courses approved by Minor Chair).

² 300-500 Level Engineering course with clear Biomedical Engineering application (BIOE 325, 341, 341L, 352, 411, 428, 450, 450L, 490; CH E 440, 542; MAT E 456; IE 571; or other courses approved by Minor Chair).

³ 300-500 Level Engineering or life sciences course with clear Biomedical Engineering application OR Bio E 490 or departmental 490 with biomedical engineering topic OR 200+-level life sciences laboratory course (if a 200-level course is chosen here, the student will need to meet the required 6 cr. of 300+ by substitution of a higher-level course for another requirement or taking an additional course).

Policies

Transfer Credits

1. By departmental policy, transfer grades of D+ or lower are not accepted for curriculum requirements.
2. A maximum of 65 credits from a 2-year school can 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 9 through 12 for courses that are also on the accepted SSH course list and <http://www.registrar.iastate.edu/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 be able to obtain a copy of your Degree Audit at any time in AccessPlus. You should check each semester to ensure that each course taken or transferred is properly applied to the correct curricular category. Ask your academic advisor to make any necessary corrections to your Degree Audit to ensure everything is correct by the semester preceding your expected term 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 in AccessPlus. 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 not having a degree audit printed.**

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.

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 (ChE 391) 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 \$6,000 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
Dr. C. E. Glatz, 2162B Sweeney Hall.

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.engineering.iastate.edu/studyabroad/>, or contact them at 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 Dr. K. R. Hebert, 2037 Sweeney Hall or
Dr. Say-Keo 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 Dr. P. J. Reilly, 2031 Sweeney Hall,
Or Nancy T. Guthrie, Study Abroad Center, 3224 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 Dr. C. E. Glatz, 2162B 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 Dr. Frank Peters, 3004 Black Engineering Hall.
You should start your plans 6-8 months before your planned departure to Ireland.

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 and fees to ISU and room and board in Lausanne. The exchange is for a full year or for the spring semester, and roughly 30 cr. toward graduation should be earned by a student taking a full course load over the year.

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, biology, and mathematics. Most 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 \$4650 at the current exchange rate) to ISU engineering students exchanging for the full year.

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 Dr. P. J. Reilly, 2031 Sweeney Hall.
The application deadline for a year-long exchange is March 15. That for
the spring is October 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/en-US/Index>.

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 on 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, visit the Turkish Embassy website at: <http://www.washington.emb.mfa.gov.tr/default.aspx>.

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. E. Glatz, 2162B Sweeney Hall, is the Ch E contact. Contact Dr. M. Akinc, 2220 Hoover Hall, or Dr. H. Ceylan, 406 Town Engr, for other details
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.engineering.iastate.edu/studyabroad/>
- ◆ 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 3.50 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 Dr. E. W. Cochran, 1035 Sweeney Hall; Dr. K. R. Hebert, 2037 Sweeney Dr. J. C. Hill, 3155 Sweeney Hall; Dr. P. J. Reilly, 2031 Sweeney Hall; Dr. R. D. Vigil, 3037 Sweeney Hall; or Dr. S. K. Mallapragada, 2114 Sweeney Hall; 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 490. 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 490. Students are strongly encouraged to participate for 2 semesters. Students may 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. They may attend group meetings on a regular basis and will be encouraged to attend the graduate research seminar (ChE 601).

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 will select these projects by consultation with individual faculty members. Election of course and topic must be approved in advance by project supervisor and faculty advisor with the completion of ChE 490 Study Proposal form on CBE Website. Upon completion of the project, a written report will be submitted to the faculty coordinator. Participation in regional student chapter meetings is also anticipated for outstanding contributions. **No more than 6 credits total of ChE 490 or other STEM departmental independent/research study may be counted towards technical electives.**

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

Faculty and Their Research Interests

(<http://www.cbe.iastate.edu/research/>)

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

M. Akinc – Processing of advanced materials, solid-liquid and solid-gas interface, synthesis of nano powders, fibers. Design and development of materials for ultra high temperature applications, infrared transmitting oxides, insulation materials.

K. M. Bratlie - We are interested in understanding biomolecule interactions with polymers through optical techniques to engineer materials for drug delivery and tissue engineering applications. The relationship between structure and the foreign body response is of great interest. We employ whole animal fluorescence imaging, nonlinear optical imaging, and a variety of biochemical assays to study these phenomena.

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.

R. Cademartiri - We are studying the interactions of biological moieties (e.g., bacteriophages, proteins, cells) with materials to generate rules which govern conjugation. Understanding the underlying rules will help us to quickly adapt our biology/materials conjugates to new challenges (e.g., different chemical environments during pathogen detection in water). As an example, simple charge based interactions will allow us to easily exchange one type of bacteriophage (a virus against bacteria) with another one to counter possible resistance of bacteria. We are also interested in the release profiles of biological moieties from materials. Formulating rules on how biomolecules release from materials, e.g., depending on the charge and density of the material and the environmental conditions, will allow us to produce slow-release systems, e.g., drug-delivery systems with high adaptability to emerging diseases.

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. Of various types of systems, we commonly use 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 and fluid dynamics applied to the chemical process industry, applied mathematics with emphasis on stochastic processes, and high-end computing and visualization engineering applications.

C. E. Glatz - I have recently ceased my bioseparations research laboratory activity. I may give some thought to possible non-laboratory activities that could be of interest to undergraduates.

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 sites where the corrosion rate is very high. Our research goal is to develop a fundamental understanding of critical chemical and physical processes involved in localized corrosion to effectively control it.

J. C. Hill – We study 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 increasing our understanding of how these biological systems work. Work is particularly focused on the sensitivity of bacteria to inhibitory compounds. Overcoming this inhibition is important for the economically viable production of biorenewable fuels and chemicals.

K. R. Jolls - My main interest is thermodynamics, the pure subject and its applications in many areas of chemical engineering that depend upon it. The functional understructure of thermodynamics is poorly understood because of the postulatory basis of the subject and the multivariate nature of the forms that represent it. Using still and animated high-performance computer graphics to show the inner workings of classical thermodynamics, we produced images never before seen.

D. D. Johnson - Theoretical materials chemistry and physics, surface and supported nanoparticle heterogeneous catalysis, alloy design and characterization, electronic-structure technique develop applications, thermodynamics and multi-scale modeling.

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 – We develop and investigate polymeric biomaterials and bioinspired materials for drug delivery, tissue engineering, and gene delivery.

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

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 and three-dimensional structures; and produce, purify, and crystallize enzymes so that their three-dimensional structures and kinetic properties can be determined.

D.K. Rollins - Our research involves informatics, mathematical modeling and process control in biomedical engineering, material science, non-destructive evaluation (NDE), and data mining. A biomedical engineering focus is in diabetes clinical research modeling the glucose response of type 1 and type 2 diabetics with the goal of improved glucose control. We are developing non-invasive monitoring systems and an artificial pancreas based on control technology and modeling. We are modeling the human thermoregulatory system to diagnose human health and diseases to improve health. Our data mining work focuses on applying multivariate statistical methods to improve identification of critical genes in a number of health science and biotechnology applications. We are developing NDE test methods to determine the ballistic integrity of armor for soldiers and vehicles.

I. C. Schneider - Our research group is interested in understanding fundamental cellular behavior that drives the progression of disease states. This 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 are made at subcellular resolution to understand how molecular processes drive cellular behavior. The goal is to use these quantitative experimental observations to guide the development of multiscale mathematical models to 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 leading to biorenewable chemicals and fuels, which can be used to replace nonrenewable fossil fuel-derived chemicals and fuels. We are interested in the selective removal of oxygen in multi-functional molecules and are evaluating the ability to have sufficiently controlled synthesis of catalytic reaction domains at the nanoscale so as to have molecularly well-defined active sites.

J. V. Shanks - Our research is specialized 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. We have developed quantitative tools (NMR, HPLC, etc.) and methodology in determining the sources of flux limitation in indole alkaloid production. The same plant tissue culture system, *C. roseus* hairy roots, is used as a model system for plant roots in phytoremediation studies. Explosives are widespread and persistent in our environment; 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.

Z. Shao - My group focuses on designing synthetic biology strategies to enable microbial factories to produce biorenewable chemicals from cheap feedstocks. In addition to *Saccharomyces cerevisiae* and *Escherichia coli*, the two most commonly used microorganisms; we are particularly interested in engineering other non-conventional yeast strains with desired features. For example, *Pichia stipitis* has the highest native ability to ferment xylose, the other major sugar in biomass hydrolysate in addition to glucose; *Issatchenkia orientalis* shows a very strong tolerance of carboxylic acids, which are important precursors used to synthesize a wide variety of compounds. In addition, we are working on constructing microbial consortia to tackle challenges which cannot be easily solved by single organisms. Lastly, we are building various high-throughput optimization approaches to improve strain robustness from a systematic level.

J.-P. Tessonnier – We are an interdisciplinary group developing sustainable solutions for the production of chemicals and energy from renewable feedstock. Specifically, we design novel heterogeneous catalysts at the nanoscale. Current topics include nanocarbons and hierarchical zeolites.

R. D. Vigil - Our current research is focused on the development of novel photobioreactors that take advantage of hydrodynamic structures to increase the frequency that phototrophic microorganisms experience light/dark cycles, which in turn increases the rate of photosynthesis and light utilization efficiency. We are also working on developing novel techniques, using seismic waves, to mobilize oil trapped in porous rocks.

Q. Wang – We research **Biomaterials**, **Intestinal Engineering**, **Nanotechnology**, and **Drug Delivery (BIND)** to provide innovative solutions and products for human health including evaluation of absorption efficacy of anticancer drug-loaded nanoparticles in intestines. Oral delivery via gastrointestinal tract is the most common drug administration route. Nanomedicine is an efficient formulation for many diseases, such as inflammatory bowel disease and colorectal cancer. However, no realistic platform to evaluate the absorption efficacy of nanocarriers to intestines exists. Single intestinal stem cells can build crypt-villus structure in vitro has the great potential to fill this gap. Undergraduate student research will contribute substantially to this blank area.

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 may also be applied 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 in the fall.

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/>.

2013-14 Officers

| | | | |
|-------------------|-----------------|-----------------|---------------------------|
| President | Jace Dendor | Treasurer | Richard Russell |
| Vice President | Nebiyou Milkias | Social Chair | Anh T Tran |
| Secretary | Eric Hessing | Webmaster | Andrew Hughes |
| ChE Car President | | Outreach Chair | German Parada |
| Senior Rep | Collin Coon | Junior Rep | Daniel Wiegel |
| Soph Rep | Jing Li | Freshman Rep | To be elected in the fall |
| Corporate Rep | Eli Reiser | Publicity Chair | Zack Heien |
| Faculty Advisor | P. J. Reilly | Faculty Advisor | K. 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.

Advisors Derrick Rollins – Ch E Malika Jeffries-EI – 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.

2013-14 Officers

| | | | |
|----------------|--|-----------|-----------------|
| President | Horaleo Ukpan | Treasurer | Christine Leise |
| Vice President | Rafael Alameda-Basora | Secretary | Thomas Croghan |
| Social Chairs | German Parada (F13) & Alex Meyer (S14) | Advisor | Laura Jarboe |

For further information, please contact Dr. L. R. 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.engineering.iastate.edu/student-services/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 1st.**

For additional information, see Dr. D. K. Rollins, 1033 Sweeney Hall or DeAnn Pitman 2162 Sweeney Hall.

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 on CMS.

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, Brenda Kutz, 2162 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/>). 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/>). 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/students/internships/>
2. Have either Brenda Kutz, Student Services Office in 2162 Sweeney, or your faculty advisor or sign the form.
3. The form is then returned to Engineering Career Services. The student will be provided the appropriate course reference number for registration.

Be sure to look at the Course Syllabus 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. View companies listed in CyHire tab on ECS website. 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*, available company literature (on the shelves at the ECS Office in Room 308 Marston Hall), and links to companies available in CMS.

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.E., 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/>. 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 or ChE 490H. Up to 6 credits of independent study or research can be used towards their professional, engineering, 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/crssprgm/reu/reu_search.cfm 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 \$2044 per month in addition** to tuition. There are also several competitive fellowships such as the National Science Foundation, Sweeney Family Memorial, 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.admissions.iastate.edu/graduate/index.php>. The application deadlines are February 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/>.

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 ensure 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/pre-health/> or <http://www.las.iastate.edu/pre-law/>). Students interested in a MBA should visit with the Business Graduate Program Office in the Gerdin Business Building (<http://www.business.iastate.edu/masters/mba>

Medical School

General requirements (in addition to the normal Chemical Engineering requirements) include: Organic Chemistry Laboratory - Chem 331L, 332L. 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 335 (4), Biol 351 (5), or Biol 423 (3); 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.