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A Note on Online Resources: Much useful information can be found directly online, and the following discussion will often refer to these recourses. Some of the most important websites are:

- SEAS Bulletin: www.bulletin.engineering.columbia.edu
- Department Of Chemical Engineering website: www.cheme.colmbia.edu
- Registrar’s Website: www.registrar.columbia.edu
A. Introduction

The faculty and the staff of the Department of Chemical Engineering extend to you a warm welcome! The Chemical Engineering program will provide you with a rich and rewarding experience. Not only does the program offer a superb and exciting training of your mind, but the degree is highly respected by employers, graduate schools (engineering, medical, law, business), and other organizations both inside and outside of the world of Chemical Engineering. During your years with us, we hope you will participate in and benefit from departmental life and enjoy many interactions with your fellow students. You will also interact with the Professors in the department and have the opportunity to discover their different fields of research and to perform research in their laboratories. Please consult the departmental web page www.cheme.columbia.edu for a full description of faculty research and other aspects of departmental life.

The aim of this booklet is to help make your stay in the department enjoyable and to assist you in taking advantage of the many intra and extracurricular opportunities.

B. Chemical Engineering: An Overview

The largest professional society serving practicing chemical engineers in the United States is the American Institute of Chemical Engineering (AIChE). Their website www.aiche.org provides a wealth of information on the history and current state of the profession.

What is Chemical Engineering?

Chemical Engineering enables the production of useful and essential chemicals and materials by processes that require controlled physical, chemical, or biological transformations. Also, Chemical Engineers develop materials and products whose functions rely on such transformations. Several key aspects of the Chemical Engineering training enabling this are not taught in any other engineering discipline (chemical equilibrium, transport of chemical species, reaction engineering, chemical separations) and this makes chemical engineers uniquely valuable among engineers. Chemical engineers are trained to analyze complex, chemically reactive systems from the molecular to the process or even global scale. The training allows chemical engineers to work not only in chemical industries per se, but also in a wide variety of other fields.

The world of Chemical Engineering has never been as rich and diverse as at present. The expertise of chemical engineers is essential to production, marketing and application in areas such as pharmaceuticals, high performance materials as in the automotive and aerospace industries, semiconductors in the electronics industry, paints and plastics, consumer products such as food and cosmetics, petroleum refining, industrial chemicals, synthetic fibers, and just about every bioengineering and biotechnology area from artificial organs to biosensors. Increasingly, Chemical Engineers are involved in new exciting technologies employing highly novel materials whose unusual response at the molecular level endows them with unique properties. Examples include controlled release drugs, materials with designed interaction with in vivo environments, “nanomaterials” for electronic and optical applications, agricultural
products, and a host of others. In a nutshell, the Chemical Engineer guides the passage of the product from the laboratory to the marketplace, from ideas and prototypes to functioning articles and processes, from theory to reality. This requires a depth and breadth of understanding of physical and chemical aspects of materials and their production which is without parallel.

**Why Choose Chemical Engineering as a Major?**

The Chemical Engineering degree is a passport to exciting careers in directly related industries as diverse as biochemical engineering, environmental management, and pharmaceuticals. Because of the deep and broad-ranging nature of the training, the degree has earned a high reputation across society. The Chemical Engineering degree is also a natural springboard from which to launch careers in medicine, law, management, banking and finance, politics, and so on. Many students choose it for this purpose, to have a firm and respected basis for a range of possible future careers. For those interested in the fundamentals, a career of research and teaching is a natural continuation of their undergraduate studies.

Regardless of what path you choose when you graduate, you will have completed a rich intellectual voyage which will equip you for the rest of your life with a deep knowledge of the physical and chemical nature of things and will give you an insight into an exploding variety of new technologies which are rapidly reshaping the society we live in.

**What do Chemical Engineers do after Graduating?**

According to AIChE’s Initial Placement Survey data, roughly half of chemical engineers graduating with an undergraduate degree take jobs in technology-based industries, while the remainder go on to graduate or professional schools, including medicine and law, or take work in other fields including finance, education, or government. The industrial opportunities are diverse, with popular areas including biotechnology, pharmaceuticals, specialty chemicals, food and consumer products.

C. **Earning a Bachelor of Science (BS) Degree in SEAS: Some General Questions**

As a student in the Fu Foundation School of Engineering and Applied Science (SEAS) your study is divided into 4 years. Your first and sophomore years of study introduce you to general principles of science and engineering. You will also study a broad range of subjects in the humanities and social sciences. In the junior-senior years, your coursework will be specialized to the major of your choice. You may also elect to take an engineering minor in another departments (see section E for examples). The detailed requirements for Chemical Engineering majors are given in section D.

**What are points?**

Every course at Columbia has a certain number of points (or “credits”) associated with it (usually 3 or 4). This corresponds roughly to the number of 50 minute lecture sessions per week for the course. If you take and pass that course you will earn that many points towards your degree. In this document, credits are often shown in parentheses after the course designator. Each course designator has a four letter prefix indicating the department (CHEN corresponds to CChemical ENgineering) followed by the course
number, followed by a letter suffix X or Y designating the term that the course is normally offered (X corresponds to fall, Y corresponds to spring). Course number in the 1000-2000’s are for the first two years, those in the 3000’s are normally junior level, while those in the 4000’s are senior/1st year graduate level.

What is a Minor?

In addition to completing the major, which earns one the Bachelor of Science (BS) degree, in Chemical Engineering, you may opt to obtain a “minor” in another SEAS department. To obtain a minor, you need to take 6 courses from a list specified in the SEAS Bulletin by the department that grants the minor. This coursework usually demands an “overload,” i.e. courses in addition to those require for the major BS. There can frequently be some overlap through the required and/or elective content in the chemical engineering program. For example, a chemical Engineering major interesting in Biomedical Engineering may use his/her technical electives to take several Biomedical Engineering courses which contribute to a minor in Biomedical Engineering. In this case to the overload needed to get the minor is reduced. You must request to include the minor as part of your degree program during registration for the fall term of the junior year. Here are a few points to keep in mind about minors:

(1) Earning a minor may require a strenuous course load and you should plan ahead to see if there are scheduling clashes. The interdepartmental nature of minors means such conflicts are more than likely to happen. If you start planning a minor early (say in your first year), you minimize the risk that scheduling problems will make it practically impossible to achieve the minor you’re interested in. Completing some of the minor requirements in advance (e.g. in your second year) is generally good advice.

(2) Chemical Engineering core courses you are required to take as part of the Chemical Engineering major may also contribute toward some minors. This is a way you can reduce your course overload further while still earning a minor. See section E for examples.

(3) Those with lighter first/sophomore year course loads due to advance placement credit in math physics or chemistry are especially well-positioned to take a minor – but still should plan their study as early as possible to avoid scheduling conflicts later.

What are electives?

An elective is a course that the student chooses, rather than a mandatory one which must be taken in order to earn the degree. A technical elective is a science/engineering elective; a non-technical elective is a humanities/social sciences elective. The BS degree in Chemical Engineering, and indeed all BS degrees in SEAS, demands 27 points of non-technical elective coursework. A fraction of this work, about 16-18 points, are not electives at all, but required non-technical courses. The balance, about 9-11 points can be chosen from a wide range of non-technical courses offered at the University. The details of the non-technical coursework needed appear in the SEAS bulletin. Beware that not all non-technical courses offered at the Morningside campus qualify as non-technical electives for engineers. The permissible courses are listed in the SEAS bulletin.
Chemical Engineering majors must also take 21 points (7 courses) of technical elective coursework. These are normally done in the junior-senior years. The technical electives must comply with the following rules:

(1) the courses must normally be 3000 level or higher

(2) the courses must be science, math, or engineering oriented and feature quantitative analysis as the core of the syllabus

(3) the total of 21 points (7 courses) of required technical electives must include one engineering course outside of chemical engineering, two courses within chemical engineering (CHEN, CHEE, CHAP), 6 pts. of courses from anywhere in SEAS, and 6 pts. of “advanced natural science” courses (i.e. courses based primarily on the natural sciences (chemistry, physics or biology) as opposed to technologies, including courses in chemistry, physics, biology, materials science, and certain engineering courses).

(4) the following sophomore level courses qualify as “advanced natural science” technical electives even though they are below 3000 level: PHYS C1403 (3), PHYS C2601 (3.5), BIOL C2005 (4), BIOL C2006 (4), BIOL W2501 (3).

(5) 3 pts of CHEN E3900 Undergraduate Research may be taken for a chemical engineering technical elective. Up to 6 pts. of CHEN E3900 may be counted towards technical elective content provided an undergraduate thesis is prepared documenting the research.

**When must I declare my major? How do I declare?**

During the first semester of your sophomore year you will declare a major online. Details about the major declaration process can be obtained from your advisor at the Center for Student Advising (CSA). If you are uncertain who your advisor is at CSA, contact the CSA staff via their website https://www.cc-seas.columbia.edu/csa.

**Does declaring Chemical Engineering as my major affect which first-sophomore year courses I should take?**

Yes. While the first two years of training for BS degrees in SEAS are similar, some important differences do exist for the various majors. Refer to the SEAS bulletin (www.bulletin.engineering.columbia.edu) for the curriculum map for the first two years.

**How do I actually Graduate? Must I apply for a degree and when?**

You must apply for a degree. The application deadline is several months in advance of the graduation date. All the details, including deadlines and application forms are available from the Registrar’s website (www.registrar.columbia.edu).

**D. Earning the Chemical Engineering Degree: The Requirements**

Please refer to the SEAS undergraduate online bulletin for the most current requirement
E. Examples of Minor Programs

Please refer to the SEAS undergraduate online bulletin for the most current requirement information: http://bulletin.engineering.columbia.edu/undergraduate-minors

F. Choosing Your Courses and Registering for Them

Much of the information below is available at Columbia Registrar’s website (www.registrar.columbia.edu).

**How should I go about choosing my courses?**

Start by consulting the SEAS bulletin and the Undergraduate Study Plan (Appendix B) for an outline of required courses. It is best to create a tentative 4-year study plan as early as possible, especially if you intend to complete a minor study abroad, or follow the premedical curriculum. Choose your technical and non-technical electives, making sure that any prior required coursework has been completed (if it has not, lay of a definite plan for its completion). Then fill out your registration form (Appendix C) tentatively (you might pencil in the courses). At this stage you may, for example, have several technical electives in mind but still be unsure about which are best to choose. Then during the designated advising periods (see next section) consult your advisor to finalize your choices. Your advisor will sign your completed registration form, then you may register online.

**What Courses are being offered next semester? When and where?**

This information can be found from the Directory of Classes (http://www.columbia.edu/cu/bulletin/uwb/). The Directory of Classes will also help you search for technical and non-technical electives outside the department. You can find out who is teaching what courses and where and when. If you want more information regarding a course, email a request to the professor who is teaching the course.

**How do I register for the courses?**

For up-to-date information and a detailed guide to registration, consult the Registrar’s website (www.registrar.columbia.edu). Registration is normally done online and about mid semester prior to the term in question (November and April). Briefly, you’ll need to select the courses you wish to take and, if applicable, obtain permission to take those courses from the instructor. Next, the selection of courses needs to be approved by your advisor. When selecting first-year or sophomore level coursework, students have their proposed programs approved by their advisor at the Center for Student Advising (CSA). In addition, students are strongly encouraged to contact a Chemical Engineering faculty advisor (see section G) with any further questions, or simply to obtain an additional viewpoint on course selections. Selection of junior and senior year courses, which involves the core of the Chemical Engineering curriculum, must be approved by a faculty advisor from Chemical Engineering (See section G). Declared majors are notified by email about
when to sign up for advising for junior-senior program approval. Attending these advising sessions is mandatory. After obtaining and advisor’s approval, students proceed to register online with the Registrar.

**How do I drop a course or add a new one?**

Obtain course add-drop forms from the Center for Student Advising (CSA), or from the Registrar’s website. Consult the relevant semester’s academic calendar, accessible online from the Registrar’s website, to find out deadlines for dropping or adding courses. Then complete the form, have it signed by your advisor, and drop/add the course before the applicable deadline.

**G. Advising**

The members of the Undergraduate Committee of the Department of Chemical Engineering serve as undergraduate advisors. The current list of advisors is available here: [http://cheme.columbia.edu/advisors](http://cheme.columbia.edu/advisors) or through CSA. A departmental advisor is always available for you as your direct link to the Chemical Engineering Department. You should feel free to consult your advisors at any time about course matters, registration, choosing technical electives, dealing with administrative problems, and of course about your personal difficulties should they arise. We strongly encourage you to stay in touch with your advisors to help make your experience here more enjoyable as well as to provide us with feedback about your progress. There are specific periods set aside for you to see your advisor when registering for courses.

**When should I see my departmental advisor?**

Formal advising is held each semester during the two weeks leading up to the registration period (April and November). Students who have declared the chemical engineering major are required to meet with a departmental advisor to review their Degree Audit Report and undergraduate study plan (Appendix B) prior to registering for the next semester’s courses. You will be notified when electronic signup for advising appointments opens. You may choose the advisor they meet with and are not required to meet with the same advisor each time, although you may choose to. Students may also meet voluntarily with their advisor at any time to revise their schedule or receive other advice as needed. Contact the advisor via email for an appointment.

Students in their first three semesters prior to major declaration may sign up for advising, but this is not mandatory because the CSA advising system has primary responsibility for these students. After major declaration students still need to remain in contact with their designated CSA Advising Deans, for a variety of reasons (e.g. add/drop requests, requests for taking incomplete in coursework, etc.) even though the primary responsibility for advising shifts to the department.

**H. Summer Internships and Research Experience Internships.**

Many students choose to use long summer breaks as an opportunity to gain
experience in the outside world of industry, technology, and research. A summer internship working for a company or research organization gives you the chance to actually practice the engineering and science you have been learning in courses at Columbia; this makes a valuable addition to your resume when you apply for permanent jobs after graduation. At the same time it may be a welcome source of summer income. If in the long term you seek a career in a certain industry, summer internships provide extremely valuable contacts. For those students who are seeking non-engineering careers after graduation, internships in whatever field of choice be it law, medicine, business or other, are equally valuable. If interested in internships, you may wish to consult with the department’s Career Placement Officer and visit our career resources website: http://cheme.columbia.edu/cheme-careers. Another source of finding out about internship opportunities is the Columbia Center for Career Education (CCE) (see http://www.cce.columbia.edu/). In addition, departmental faculty and the AIChE student chapter frequently organize events aimed at promoting industry contacts/hiring.

**Research Experience for Undergraduates**

An alternative and highly stimulating way to spend the summer is by participating in a National Science Foundation sponsored REU program (Research Experience for Undergraduates). The admission criteria may be quite stringent, and participation in these programs is a prestigious addition to the student’s resume. The REU provides opportunities to participate in state-of-the-art research either in the department or at REU sites in other institutions throughout the country for about ten weeks. REU sites are established in all fields of science, mathematics, and engineering. The students will work with graduate students and a faculty mentor on a current research project. The experience will also be enriched by seminars as well as extracurricular social interactions. Students are granted stipends, and in some cases assistance with housing and travel. At the website www.nsf.gov you can search for the full list of REU sites as well as application procedures and deadlines. This site will also tell you whether there are any active REU programs at Columbia University during the summer of interest.

**Summer Research with a Columbia Professor**

Another stimulating way to spend your summer is working in the research group of a member of faculty in the Chemical Engineering Department or some other department on campus. You can learn about areas of research in Chemical Engineering from the departmental website under the Faculty link and obtain further details by contacting individual faculty directly to find out more about their research and to establish if they have summer vacancies. For other departments, you can go to the departmental website (start from www.columbia.edu) and do the same.

I. Extracurricular Activities

You’ll find online links to a huge number of extracurricular organizations at Columbia’s extracurricular groups’ page www.columbia.edu/cu/groups.html. This is your chance as a Columbia student to be actively involved in all kinds of activities: artistic, cultural, dramatic, social, ethnic, sporting, journalistic, musical, political, and many, many others.
Of special interest to Chemical Engineers is the American Institute of Chemical Engineers (AIChE) student organization. This is a forum for student activity in research, industrial experience, conferences, and career opportunities. The AIChE student organization has annual elections to fill its positions. Naturally, the student chapter interacts with the Chemical Engineering Department and its faculty to make student life in the department more exciting and productive. For details, see the AIChE website at www.columbia.edu/cu/aiche/.

Other organization specifically concerned with student engineers include:

- Engineering Student’s Council (www.columbia.edu/cu/esc/)
- Society for Women Engineers (www.seas.columbia.edu/swe/)
- Society for Black Engineers (www.columbia.edu/cu/nsbe/)
- Asian American Society of Engineers (www.columbia.edu/cu/sa/resourc/cosnt/aase.html)

APPENDIX A. Educational Objectives of the Department of Chemical Engineering.

OBJECTIVES

1. Prepare students for careers in industries that require technical expertise in chemical engineering.

2. Prepare students to assume leadership positions in industries that require technical expertise in chemical engineering.

3. Enable students to pursue graduate-level studies in chemical engineering and related technical or scientific fields (e.g. biomedical or environmental engineering, materials science).

4. Provide a strong foundation for students to pursue alternative career paths, especially careers in business, management, finance, law, medicine, or education.

5. Establish in students a commitment to life-long learning and service within their chosen profession and society.
APPENDIX B. Undergraduate Study Plan Form
Undergraduate Study Plan
Department of Chemical Engineering, Columbia University
(DVE Revision 1/18/2018)

All Chemical Engineering undergraduates must complete this form and have it approved by an Undergraduate Committee advisor. This form is to be completed before meeting with your advisor.

Instructions:
1) Fill in all courses that you have taken, and those courses that you plan to take during the remainder of your time at Columbia.
2) Where course numbers are listed, circle the course numbers corresponding to courses you have already completed.
3) Where blanks are provided, write in the course number (and name, if requested). For these entries, circle the course numbers for courses you have completed, and write “IP” next to courses that are currently in progress.
4) If you placed out of any courses, circle the course number and write “AP” next to the circle to indicate advanced placement.

1. Non-Technical Course Requirements* Points
   a. University Writing: ENGL CC1010(3) ___
   b. Economics: ECON UN1105(4) and UN1155(0) Recitation ___
   c. Art/Music Humanities (choose one): HUMA UN1121(3) or HUMA UN1123(3) ___

2. Core Humanities Requirement* (choose one two-course sequence):
   Sequence 1: Literature Humanities: HUMA CC1001(4) and HUMA CC1002(4) ___
   Sequence 2: Contemporary Civilization: COCI CC1101(4) and COCI CC1102(4) ___
   Sequence 3: Choose two Global Core courses from list of approved courses in Columbia College Bulletin (6-8 points)

   Course #: Course #: Course #: ___

3. Non-Technical Electives* (List of approved courses in SEAS Bulletin, total 9-11 points)

   Course #: Course #: Course #: ___

   *Note: the total credits from sections 1., 2., and 3. must add up to at least 27 credits

4. Engineering Fundamentals
   a. The Art of Engineering: ENGI E1102(4) ___
   
b. Intro to Comp for Eng/App Sci (Python-based): ENGI E1006 (3) ___

5. Physical Education: PHED UN1001(1) and PHED UN1002(1) ___

6. Mathematics Requirement
   a. Calculus: MATH UN1101(3) UN1102(3) APMA E2000 (4) ___
   
b. ODE (choose one course): MATH E1210(3) or APMA E2101(3) ___
   
c. Math Elective*: Course #: ___

   *Choose from ORCA 2500, APMA(E3101, E3102, E4001, E4150, or E4300), MATH UN2010, , STAT GU 4001, or another course approved by the major advisor.

7. Chemistry Requirement (Choose one track) (note: the university division designator for all of these courses is UN)

   Track C1: 1403(4) 1404(4) 1500(3) 2443(4) 2495(1.5)^ 2496(1.5)^ ___


   Track C2: 1604(4) 1507(3) 2443(4) 2495(1.5)^ 2496(1.5)^ ___

   Int. Chem Int. Chem Lab Orgo I. Orgo Lab I Orgo Lab II

   Track C3: 2045(4) 2046(4) 1507(3) 2495(1.5)^ 2496(1.5) ___

   Int. Orgo Int. Orgo Int. Chem Lab. Orgo Lab I Orgo Lab II

   *note on orgo lab: if you are a senior, then you likely took the 3 credit course UN3543 and you can circle both 2495 and 2496 in this form. Also note that the intensive organic chemistry lab course UN2545(3) can count in place of 2495 and 2496.
8. Physics Requirement: (Choose one track)

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<th>PHYS UN1401(3)</th>
<th>UN1402(3)</th>
<th>Lab-UN1493(3)</th>
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<td>UN1602(3.5)</td>
<td>Lab-UN1493(3)</td>
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<td>Track P3:</td>
<td>UN2801(4.5)</td>
<td>UN2802(4.5)</td>
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9. Chemical Engineering Requirements:

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<td>CHEN E3110(3)</td>
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<tr>
<td>Spring:</td>
<td>CHEN E3120(3)</td>
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<tr>
<td>Fourth Year: Fall:</td>
<td>CHEE E4140(3)</td>
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<tr>
<td>Spring:</td>
<td>CHEN E3810(3)</td>
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10. Required Technical Electives: (7 courses total)

   a. Engineering courses within chemical engineering (CHEN, CHEE, or CHAP)
      1. Course name: __________________________  2. Course name: __________________________
         Course #: __________________________  Course #: __________________________

   b. Engineering course outside chemical engineering (not CHEN, CHEE, or CHAP)
      3. Course name: __________________________
         Course #: __________________________

   c. Engineering courses (anywhere in SEAS)
      4. Course name: __________________________  5. Course name: __________________________
         Course #: __________________________  Course #: __________________________

   d. Advanced Science courses (Chemistry, Physics or Biology content– one must be outside of SEAS)
      6. Course name: __________________________  7. Course name: __________________________
         Course #: __________________________  Course #: __________________________

11. Additional Courses (enter course numbers only):

   _______  _______  _______  _______

TOTAL POINTS*:

*Total points must be \( \geq 120 \) credits for the normal 4 year track, or \( \geq 60 \) credits for Combined Plan students

______________________      _______________  __________________    ________________
Advisor Signature          Date  Student Signature                 Date
APPENDIX C. Registration Form
DEPARTMENT OF CHEMICAL ENGINEERING
Prof. Alan West, Chair
Dept. Administrator
Office: 801 Mudd, Phone: 212-854-4453; Fax 212-854-3054

Advisor’s Name: __________________________________________
This form must be completed and signed by your advisor before you register (Please Print)

NAME: ___________________________  CUID# ______________________
GRADUATION YEAR: ________________
STUDENT ID NUMBER: _______________________ 

CAMPUS ADDRESS : ________________________________________________
_________________________________________________________________
_________________________________________________________________

PHONE NUMBER: (       ) _____- __________
E-MAIL: ______________________________
DEGREE SOUGHT: ☐ BS ☐ MS ☐ SP ☐ PROF ☐ DES ☐ PhD   YEAR: ________________
COMBPLN: ______________________ SCHOOL: ______________________

APPROVED COURSE FOR: ☐ FALL    ☐ SPRING

<table>
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<th>Course</th>
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TOTAL

ADVISOR’S SIGNATURE: ______________________   DATE: ____________
DEPARTMENT APPROVAL: ______________________ DATE: ____________

Look on reverse side for details and instructions
UNDERGRADUATES

When preparing your program for registration, keep the following in mind:

* **FULL TIME STATUS:** Although SEAS requires only 12 points for full time status, the Department requires a minimum of 15 points per term.

* **MAJOR REQUIREMENTS**

In both the 1st Year/Soph and Jr./Sr. programs, certain technical courses are required; these are defined for Chemical Engineers in the appropriate section of the current SEAS Bulletin. Make sure you have fulfilled prior major requirements for the term in question.

* **NON-TECHNICAL ELECTIVE REQUIREMENTS**

You need 27 non-techs to graduate (see SEAS bulletin). Normally, 9-11 points are to be taken during the Jr.-Sr. program, i.e. you should have completed 16-18 points during the 1st Year/Soph program. Note that among the 16-18 points in the 1st Year/Soph program you **must** take certain courses (i.e. these 16-18 points are not totally free electives); the “must-do” courses are listed in the SEAS Bulletin section on non-technical requirements. In the Jr/Sr program, the 9-11 points of non-techs are almost free; the SEAS Bulletin defines what courses can and cannot serve as a non-techs (for further clarification see your advisor).

* **TECHNICAL ELECTIVE REQUIREMENTS:** In both the 1st Year/Soph. and Jr./Sr. programs there are technical elective requirements, defined in the Chemical Engineering section of the SEAS Bulletin. The Jr/Sr program includes 21 points of tech. electives. The following stipulations apply:
  ✓ the courses must normally be 3000 level or higher
  ✓ the courses must be science, math, or engineering oriented and feature quantitative analysis as the core of the syllabus
  ✓ Two tech. electives must be within chemical engineering (i.e., they must have a course designator of \textit{CHEN} or a mix between \textit{CHEN} and another SEAS department. e.g. \textit{BMCH, CHEE, CHAP}, etc).
  ✓ One technical elective must be within SEAS but taken outside of chemical engineering (that is, a course with a designator other than \textit{BMCH, CHEN, CHEE, or CHAP}).
  ✓ Two technical electives must be within SEAS (may or may not be within chemical engineering).
  ✓ Two technical electives must contain “advanced science” coursework, which can include chemistry, physics, biology, and certain engineering courses. Qualifying engineering courses are determined by Chemical Engineering Department advisers. At least one of these classes must be taken outside of SEAS (i.e. in a science department at Columbia)
  ✓ At most, only one computer science (COMS or IEOR) class can be counted towards the technical elective requirement.
  ✓ The following sophomore level courses qualify as “advanced natural science” technical electives even though they are below 3000 level: PHYS C1403 (3), PHYS C2601 (3.5), BIOL C2005 (4), BIOL C2006 (4), BIOL W2501 (3), CHEM2444.
  ✓ 3 pts of CHEN E3900 \textit{Undergraduate Research} may be taken for a chemical engineering technical elective. Up to 6 pts. of CHEN E3900 may be counted towards technical elective content provided an undergraduate thesis is prepared documenting the research.

The department recommends focusing electives in one technical area, for example, in Material Science, Biotechnology, Environmental Engineering, etc.. Introductory and/or prerequisite courses in these areas are listed in the minor programs in the SEAS Bulletin.

* **Useful links and Resources:**
  • Columbia directory of classes: \url{http://www.columbia.edu/cu/bulletin/uwb/}
  • Columbia SEAS bulletin: \url{http://bulletin.engineering.columbia.edu/}
  • Key to designators and course numbers: \url{http://bulletin.engineering.columbia.edu/key-course-listings}
  • SEAS minors & requirements: \url{http://bulletin.engineering.columbia.edu/undergraduate-minors}