

Appendix III

Undergraduate Handbook

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Undergraduate Handbook and Curriculum Guide

Department of Chemical Engineering

Columbia University

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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 resources. Some of the most important websites are:

- SEAS Bulletin: accessible from www.engineering.columbia.edu/
- Department Of Chemical Engineering website: accessible from www.engineering.columbia.edu/
- Registrar's Website: www.columbia.edu/cu/registrar/

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. A particularly useful overview can be found there in the document "A Century of Achievement--Vision for the Future: 1908-2008."

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. The training allows chemical engineers to work not only in chemical industries per se, but also in a wide variety of other fields, in stark contrast to other engineering disciplines.

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.

The role of the Chemical Engineer is central. 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?

The *AICHE*'s Initial Placement Survey data indicates that since 2000, only about half of graduating chemical engineers take jobs in technology based industries, with the remainder going on to graduate or professional schools, including medicine and law, or taking work in other fields including finance, education, or government. The industrial opportunities are surprisingly diverse. The table below shows the percentages of employment of chemical engineers in various areas in 2007 according to *AICHE*'s most recent "Salary Survey."

Area of Employment	2007
Chemical/Industrial Gases/Plastics/Rubber/Soaps/Fibers Glass/Metals/Paper	25.5
Food/ Ag Products / Ag Chem	5.0
Energy/Petroleum/Utilities	17.3
Electronic/Materials/Computer	3.7
Equipment/Design/Construction	14.3
Environmental, Health and Safety	3.4
Aerospace/Auto	2.1
R&D	3.4
Government	4.4
Biotech	3.7
Pharmaceutical/Healthcare	7.6
Professional (includes Education)	8.4
Other	1.5

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: First Year = 1st year, Sophomore Year = 2nd year, Junior Year = 3rd year, Senior Year = 4th Year. 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. The program for all engineering students in these first two years is to some extent similar, regardless of which major the student end up selecting. There are a few important differences, however. For example, students who end up majoring in chemical engineering are required in their sophomore year to take some courses not necessarily required for other engineering majors (see section D).

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 give 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 Chemical 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 required 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 interested 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 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 15 points (5 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 15 points (5 courses) of required technical electives must include one engineering course outside of chemical engineering, two courses within chemical engineering (CHEN, CHEE, CHAP), and 9 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). Note that one chemical engineering elective course must be an advanced natural science elective.
- (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.

The department recommends focusing electives in one technical area, for example, in Material Science, biology related science and technology (e.g. Biology, Biophysics, Biomedical Engineering), Environmental Engineering/Science or engineering management. Introductory and/or prerequisite courses in these areas are listed in the minor programs in the SEAS Bulletin.

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 www.studentaffairs.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. Chemical Engineering majors do the four term calculus sequence plus an ordinary differential equations course; either MATH E1210 or APAM E2101 can serve this purpose. A full first year of “freshman” chemistry is needed along with its lab, plus a term each of organic chemistry and organic chemistry lab. While the latter is normally done in the junior year, ambitious students can do it earlier. Two terms of first year physics, along with the lab course, are also required. These basic math and science requirements are almost universal for all engineers in SEAS, although we demand a bit more chemistry, naturally!

Note that chemical engineering majors are not required to take a computer science programming course in the first year. Also, although any pre-professional elective is allowed, we encourage intended majors to take CHEN E1040. An important course specific to the major and

required in the fall of sophomore year (term III) is CHEN 31000 Material and Energy Balances. If this course is missed by a late declaration or change in major for example, it can still be done in the junior year without much difficulty.

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

You must apply for a degree. Degrees are awarded three times a year and it is up to you to choose when you want to graduate (the most commonly chosen date is in May). The application deadlines depend on when you want to graduate. These deadlines are several months in advance of the graduation date. Application forms are available from the Chemical Engineering main office or you can print them directly from the web. All the details, including deadlines and application forms are available from the Registrar's website.

D. Earning the Chemical Engineering Degree: The Requirements

Please refer to the SEAS undergraduate online bulletin for the most current requirement information: bulletin.engineering.columbia.edu/ and from there follow the links to the Undergraduate Degree Tracks under Chemical Engineering.

E. Examples of Minor Programs

Please refer to the SEAS undergraduate online bulletin for the most current requirement information: bulletin.engineering.columbia.edu/ and from there follow the link Undergraduate Minors.

F. Choosing Your Courses and Registering for Them

Much of the information below is available at Columbia Registrar's website.

How should I go about choosing my courses?

Early in the preceding semester, consult the SEAS Bulletin section mentioned in Part D

above to see what courses you should expect to take. 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). The important point is to plan ahead so as not to leave yourself an excessive load in the final semesters of your study. Then obtain your registration form (see below) and fill it out 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.

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

You must be sure to register only for courses which will actually be offered, and whose meeting times do not conflict. This information can be found from the Directory of Classes accessible from the Registrar's website and the SEAS website. 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 course syllabi, email a request to the professor who is teaching the course. To find faculty email addresses, go to the webpage for the department the professor is in, or search for him/her at Columbia University's main homepage www.columbia.edu.

How do I register for the courses?

For up-to-date information and a detailed guide to registration, consult the Registrar's website. Registration is normally done online and about mid semester prior to the term in question. 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 the appropriate 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 an 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. The add and drop dates are different; the former is a week or so after the first day of class, while the latter is after midterms.

G. Advising

You have at your disposal two advisors during your four year stay at Columbia, a CSA and a departmental advisor. Find out who these individuals are at the CSA and Chemical Engineering department websites, respectively. 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 during the junior-senior years.

When should I see my departmental advisor?

- At the beginning of each semester (usually for students processing program changes, transfer credits, 3-2 participation, etc).

- Middle of the fall semester (i.e. just before registration for the following spring).
- Middle of the spring semester (i.e. just before registration for the following Fall).

The above mid-semester meetings are mandatory for students registering into the Junior and Senior programs.

Who is my departmental Advisor?

There is a departmental advisor for every semester of the 4-year program. You can find out who your advisor is by going to the Chemical Engineering Department website and follow the [Undergraduate Program](#) link to [Advisors](#).

How do I arrange appointments with my departmental advisor?

You will be informed when and where to go by email or by announcement during one of your classes. If you wish to see your advisor at other times, don't hesitate to make an appointment by email (you'll find your advisor's email address in the Advisor section on the departmental website).

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 visit the chemical engineering departmental office and ask to see the "Internships Folder" and other relevant materials maintained there. Also, students are encouraged to mail their resumes (or to

enter them online, as is increasingly the case) to companies to inquire about internships – many large companies have internship programs that they operate during summers. The more active you are in seeking an internship the better your chances are at success. You can also ask individual faculty if they have any contacts which may help secure a summer internship position. Another source of finding out about internship opportunities is the Columbia Center for Career Education (CCE). CCE exists as a bridge for students between the academic world and their future careers (see <http://www.cce.columbia.edu/>). You can register to use the programs and services at CCE. You will then receive email notices from CCE when potential employers of interest to you are visiting campus to conduct interviews etc. Your resume will be needed by CCE by certain deadlines depending on the date of the visit of the companies. Registering with CCE also entitles you to access their internship databases, and other services such as career counseling, alumni connections, information about various upcoming events, and so on. Also, be aware that the department designates a departmental advisor devoted to career development activities. He/she is nominally assigned to advise the spring term of the senior year, but he/she is available to counsel any student seeking summer employment. This special advisor can apprise you of special events/opportunities that can result in internships. For example, the *AIChE* student chapter frequently organizes events aimed at promoting industry contacts/hiring. These events are another resource for the internship-seeker that the spring term senior advisor can inform you of.

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)

J. Life on Campus: Practical Issues

Life as a student includes practical needs such as medical treatment, textbook resources, household goods and so forth. For a general orientation, visit the Columbia students' page www.columbia.edu/cu/students/ where you will find links to information and services of importance to Columbia students. See also the Columbia University Facets page www.columbia.edu/cu/facets/.

Where can I find course textbooks?

Current textbooks are usually available at Lerner Hall bookstore (Broadway and 115th St); see www.columbia.bncollege.com. Also Book Culture (www.bookculture.com) at 112th St between Broadway and Amsterdam. You may also try online bookstores such as www.amazon.com and www.bn.com.

How do I navigate my way around campus?

For online campus maps consult www.columbia.edu/about_columbia/map/.

Nearest banks?

There are ATM machines on campus in Lerner Hall and in the School of International and Public Affairs (SIPA). Several banks are located in the Morningside Heights neighborhood, such as Chase on Broadway and 113th, Citibank at 111th and Broadway, and 124th and Amsterdam.

Hardware stores?

Two near campus are Columbia Hardware at 114th and Broadway and Clinton Supply on Amsterdam and 122nd Street.

Where can I find computing help?

Consult the Columbia Information Technology page at cuit.columbia.edu.

How do I contact Columbia Security in an emergency?

Dial extension 4-5555 from a campus phone for emergencies (dial 854-5555 from outside).

Also, there are emergency call boxes throughout the Morningside campus.

What are the dining options on campus?

See the Columbia dining services website at www.columbia.edu/cu/dining/.

Nice local restaurants?

There are a host of restaurants serving many types of cuisine between 116th and 100th Streets along Broadway. Some of them are very good and many deliver.

Nearby grocery stores?

Try the University Food Markey (“UFM”) at 115th and Broadway, or the West Side Market at Broadway and 110th St.

How can I found out about medical services or psychological counseling?

Visit the Health Services website at www.columbia.edu/cu/health.

Where can I ask questions about financial aid?

Visit the webpage of Columbia Student Financial Services (www.columbia.edu/cu/sfs/) for more information on all issues concerning billing, payments, and financial aid including the work study program.

What’s exciting in New York City?

Try newyork.sidewalk.citysearch.com/ and the Village Voice newspaper.

K. The University Campus and New York City

The attractive 32-acre Morningside campus, on the hill of Morningside Heights, is built predominantly in the Italian Renaissance style with picturesque landscaping. It extends from 114th Street in the south to 120th Street in the north, and from Amsterdam Avenue to Broadway. West of campus lies the Hudson River and Riverside Park, and the campus is also close to Central Park. The neighborhood is home to numerous renowned educational institutions with which Columbia is affiliated such as Teachers and Barnard Colleges, Manhattan School of Music, and

the Union and Jewish Theological Seminaries. Columbia has one of the top ten largest academic libraries in the nation and a well-equipped physical fitness center. Much of Columbia's large collection of art is on view in campus libraries, lounges, offices, and outdoors including several notable sculptures. Try to visit Miller Theater on 116th Street and Broadway for the performing arts. A focus for student activities on campus is Lerner Hall where you will find a wealth of activities and services from computer use, counseling services, club activities, dining, and simply meeting your friends (see www.columbia.edu/cu/lernerhall/ for details).

Other places of interest near campus include the largest Gothic cathedral in the world, St. John the Divine, at 112th Street and Amsterdam Avenue. Riverside Church boasts interesting stained-glass windows and the long Riverside Park is a pretty setting for a stroll or Sunday picnic. Further uptown at 168th Street is the Health Sciences Campus, including the Columbia Presbyterian Medical Center.

Life on campus cannot, of course, be separated from life in New York City. The great Metropolis comprises the central island of Manhattan along with four outer Boroughs: Brooklyn, Queens, the Bronx, and Staten Island. From north to south the island of Manhattan is about thirteen miles long and from east to west roughly two miles wide. Getting around is convenient with subways, buses, or yellow cabs. You will find almost everything in New York City. There are of course famous places like Times Square, Fifth Avenue, Central Park, Broadway, Rockefeller Center, the Empire State Building, to name a few. You may also want to take a ferry to the Statue of Liberty and Ellis Island or visit the United Nations. A feast of art is available at the magnificent Metropolitan Museum of Art, the Museum of Modern Art, the Whitney Museum, The Frick Collection, The Guggenheim Museum, and many others (the city has more than 150 museums). Concerts, opera, and ballet at the Lincoln Center for the Performing Arts and the vital theater life on and off Broadway are all part of life in New York. There are also the different ethnic neighborhoods of Lower Manhattan, from Chinatown to the ever-diminishing Little Italy; and the artsy concentrations in SoHo, TriBeCa, and the East and West Village. The city is filled with magnificent modern architecture and in some areas the older brownstones survive. New

York City can probably boast to be the eating capital of the world, with an immense variety of ethnic restaurants and specialty food shops. Bars and clubs of all types abound and music of every style is available. You can find much more information about living in New York and other aspects of this exciting city at websites such as <http://newyork.sidewalk.citysearch.com/>, <http://www.columbia.edu/cu/nyc/>, <http://www.columbia.edu/cu/facets>, and <http://www.panix.com/~clay/nyc/query.cgi/G2>.

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

Department of Chemical Engineering
Columbia University
Undergraduate Study Plan
(CJD Revision 08/15/2011)

Directions:

All Chemical Engineering undergraduates **must** complete and sign this form and have it approved by an Undergraduate Committee advisor during the 1st semester of their junior year.

- 1) Carefully plan the remainder of your academic career and indicate your course selections to fulfill **all** of your requirements on this form. Either circle the courses taken from the list below or fill in the complete course number in the appropriate blanks; leave point tallies blank for your advisor to fill out
- 2) If you placed out of a course or courses, circle the course number and denote this by placing a small AP adjacent to the circle to indicate advanced placement

1. a. Mathematics-Calculus: (Choose one track)

Points

Track M1: V1101(3) V1102(3) V1201(3) V1202(3)

Track M2: V1105(4) V1106(4) V1205(3)

b. Mathematics-ODE (choose one course): Mathematics E1210(3) or APMA E2101

2. Physics: (Choose one track)

Track P1: C1401(3) C1402(3) Lab-C1493(3)

Track P2: C1601(3.5) C1602(3.5) Lab-C1493 (3)

Track P3: C2801(4.5) C2802(4.5) Lab-W3081(2)

3. Chemistry: (Choose one track)

Track C1: C1403(3.5) C1404(3.5) C1500(3) C3443(3) C3543 or C3545(3)

Track C2: C1604(4) C2507(3) C3443(3) C3543 or C3545(3)

Track C3: C3045(3.5) C3046(3.5) C2507(3) C3543 or C3545(3)

4. English Composition: (Choose one track)

Track E1: C1010(3)

Track E2: Z1003(0) C1010(3)

Track E3: Z0006(0) Z1003(0) C1010(3)

5. Professional Engineering Elective: (List one course)

6. Physical Education: C1001(1) and C1002(1)

7. First Year Design: E1102(4)

8. Non-Technical Electives: (List courses selected from Bulletin List B that total 9 points)

9. Non-Technical Core Electives

- a. Economics: ECON W1105(4) and W1155(0) Recitation _____
- b. Art/Music (choose one course): HUMA C1121(3) or HUMA C1123(3) _____
- c. Two semester humanities course sequence (choose one two-course sequence):
 HUMA C1001-1002; or COCI C1101-C1102; or two Major Culture courses from
 Bulletin List A; or a List A and a List B or C course in the same culture. _____

10. Chemical Engineering Requirements:

Second Year:	E3100(4)				_____
Third Year:	E3110(3)	E3010(3)	E3020(2)		_____
	E3120(3)	E3210(3)	E4230(3)	E3220(2)	_____
Fourth Year:	E4140(3)	E4300(2)	E4500(4)		_____
	E3810(3)	E4510(4)			_____

11. Required Technical Electives: (List courses to total 15 points; at least two chemical engineering courses are required, at least one engineering course outside of chemical engineering is required, and at least 9 points must qualify as “advanced natural science” (i.e., chemistry, physics, biology, materials science, and some science-based engineering courses; you can discuss choices with your advisor).

_____	_____	_____	_____
Advanced natural science	Advanced natural science	Advanced natural science	
_____	_____	_____	_____
Engineering (not CHEN, CHEE or CHAP)	Chemical Engineering (CHEN, CHEE or CHAP)		

12. Additional Courses:

_____	_____	_____	_____	_____	_____
				TOTAL POINTS	_____

Advisor Signature

Student Signature

Date

Date