Master of Science in Chemical Engineering Program

Department of Chemical Engineering

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Columbia University...
... in the City of New York

“An ever heightening sky for human thought, an ever widening horizon for human knowledge, and absolute truthfulness in the expression of the light within, these are the distinguishing marks of a great university.”

Seth Low, Columbia University President, 1890

(2016 Holiday Card from Columbia University President Lee C. Bollinger)
Outline

- Introduction
- Background and History
- The Chemical Engineering Profession
- Academic Integrity
- Master of Science in Chemical Engineering
  - Goal
  - Time to complete
  - Core Courses
    - Program for Student with BS in ChemE
    - Program for Student without a BS in ChemE
      - Scientist to Engineer (S2E)
    - Technical Electives
    - Department Colloquium
    - MS Colloquium
  - Advising
  - Applying for the degree
    - Applying for Ph.D.
    - Faculty and Staff
    - Research
    - Columbia ChemE Grad Student Life and NYC
    - Career Placement & Employers
    - Housing
    - Questions

- What courses must I take?
- What elective courses may I take?
- What colloquium course must I attend?
- How does advising work?
- How do I apply for the degree?
Background- “What exactly does a chemical engineer do?”

“... they use science and mathematics, especially chemistry, biochemistry, applied mathematics and engineering principles, to take laboratory or conceptual ideas and turn them into value added products in a cost effective, safe (including environmental) and cutting edge process. From the development of smaller, faster computer chips to innovations in recycling, treating disease, cleaning water, and generating energy, the processes and products that chemical engineers have helped create touch every aspect of our lives.”

Background- chemical engineers...

“Design chemical plant equipment and devise processes for manufacturing chemicals and products, such as gasoline, synthetic rubber, plastics, detergents, cement, paper, and pulp, by applying principles and technology of chemistry, physics, and engineering.”

**Sample of reported job titles:** Process Engineer, Chemical Engineer, Engineer, Scientist, Project Engineer, Development Engineer, Engineering Scientist, Process Control Engineer, Process Development Engineer, Refinery Process Engineer

Background - Engineering and the Columbia Engineering School

"Give me lever long enough and somewhere to stand and I will move the world." Archimedes (287-212 B.C.)

Columbia Engineering Mission Statement

“Columbia Engineering, The Fu Foundation School of Engineering and Applied Science at Columbia University in the City of New York, prepares talented students to become innovative, socially responsible leaders in industry, government, and academia. Our education is grounded in the fundamental principles and creative approaches of engineering, while being critically informed by the broader perspective of a distinguished liberal arts education. This interdisciplinary education mission is enriched by a research endeavor focused on expanding the knowledge base of engineering and creating technological solutions that serve society. Columbia students, faculty, and alumni strive to improve the human condition locally, nationally, and globally with their enthusiasm to learn, to question, and to solve some of the world’s most pressing current and future challenges.”

Engineers “...discover, invent, innovate, create...”
The School of Engineering and Applied Science founded in 1864 as the School of Mines (150th celebration in 2014)

Named in 1997 in recognition of Z.Y. Fu, a major benefactor.

In the forefront of collaborative research and teaching Columbia engineers invented the FM radio, long distance telephony, mass production of antibiotics and the first robots and changed transportation with steam engines, railroads, the Panama Canal, and NYC subways.
The Department of Chemical Engineering founded in 1905 (110th anniversary in 2015) largely due to Professor Charles Frederick Chandler

“…Electrochemistry, Polymers, Bioengineering… Materials, Energy, Environment, Data Sciences…”

Professor Charles Frederick Chandler (1836–1925)

“The Mission of the Department of Chemical Engineering at Columbia University is to provide an outstanding academic and research experience to students to prepare them to meet the needs and challenges of the 21st century.”

History

Use of images and text references:
- Image 1: Unit Operations Lab ~1929
- Image 2: Professor Charles Frederick Chandler (1836–1925)
- Image 3: Professor Elmer Gaden
- Image 4: Prof Carl Gryte and polymer research team circa 1971
- Image 5: Previous Heat Transfer Research Facility

Text references:
- [Gryte, Carl C. Chemical Engineering at Columbia, Chem Eng Education, ASEE 2006]
- (Kumar, Sanat, Dept of Chemical Engineering Alumni Newsletter 2011-2012)
- (http://pubs.acs.org/doi/abs/10.1021/cen-v049n022.p027 accessed 19 Feb 2016)
Consider being a part of the Chemical Engineering Profession and your Professional Reputation

Consider joining the professional organizations listed on this slide.


Be a part of the Chemical Engineering Profession and your professional reputation

Members of AIChE are expected to uphold the AIChE code of ethics.

“R.S.V.P.” Better to cancel than to be a “no show”.

Source: www.aiche.org/about/code-ethics

The Quebec Bridge collapsed on 11 September 1916 a second time due to poor design work and materials. The bridge, which was conceived to be one of the most advanced in the world, had already collapsed under similar circumstances in 1907. Eighty-five workers perished in that tragedy prompting a Dominion Royal Commission to investigate the catastrophic failure. The findings of the Commission placed the failure solely on the engineer design and management of the project. To this day, all graduating engineers from Canadian universities receive iron rings to remind them of this event and the social responsibility they have in the proper design and execution of projects.”

The Engineering Profession and Academic Integrity Sources

- National Society of Professional Engineers’ (NSPE) Creed, Adopted Jun 1954
- NSPE provided rights to U.S. Army Engineers to use NSPE Creed, 9 Oct 2013
- Order of the Engineer “Upholding Devotion to the Standards and Dignity of the Engineering Profession” since Jun 1970
- Columbia Engineering Graduate Student Affairs

The Engineering Profession

Engineers' Creed

“As a Professional Engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare. I pledge: To give the utmost of performance; To participate in none but honest enterprise; To live and work according to the laws of man and the highest standards of professional conduct; To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations. In humility and with need for Divine Guidance, I make this pledge.”

Adopted by National Society of Professional Engineers, June 1954. See more at:

The Engineering Profession

Order of the Engineer Obligation: “I am an Engineer. In my profession I take deep pride. To it, I owe solemn obligations.

Since the Stone Age, human progress has been spurred by the engineering genius. Engineers have made usable nature’s vast resources of material and energy for Humanity’s [Mankind’s] benefit. Engineers have vitalized and turned to practical use the principles of science and the means of technology. Were it not for this heritage of accumulated experience, my efforts would be feeble.

As an Engineer, I pledge to practice integrity and fair dealing, tolerance and respect, and to uphold devotion to the standards and the dignity of my profession, conscious always that my skill carries with it the obligation to serve humanity by making the best use of Earth’s precious wealth.

As an Engineer, [in humility and with the need for Divine guidance,) I shall participate in none but honest enterprises. When needed, my skill and knowledge shall be given without reservation for the public good. In the performance of duty and in fidelity to my profession, I shall give the utmost.”

Note: Brackets indicate the original wording of the Obligation. Either wording is acceptable, but new certificates have the newer wording.
Academic Integrity

Student Conduct

“The continuance of each student upon the rolls of the University, the receipt of academic credits, graduation, and the conferring of the degree are strictly subject to the disciplinary powers of the University.

Although ultimate authority on matters of student discipline is vested in the Trustees of the University, the Dean of the School and his staff are given responsibility for establishing certain standards of behavior for Columbia Engineering students beyond the regulations included in the Statutes of the University and for defining procedures by which discipline will be administered.

We expect that in and out of the classroom, on and off campus, each student in the School will act in an honest way and will respect the rights of others.”
Academic Integrity

“Academic integrity defines a university and is essential to the mission of education. At Columbia, *students are expected to participate in an academic community that honors intellectual work and respects its origins*. In particular, the abilities to synthesize information and produce original work are key components in the learning process. As such, a violation of academic integrity is one of the most serious offenses a student can commit at Columbia and can result in dismissal.

Students rarely set out with the intent of engaging in violations of academic integrity. But classes are challenging at Columbia, and students will often find themselves pressed for time, unprepared for an assignment or exam, or feeling that the risk of earning a poor grade outweighs the need to be thorough.

Such circumstances lead some students to behave in a manner that compromises the integrity of the academic community, disrespects their instructors and classmates, and deprives them of an opportunity to learn.

In short, they cheat. Students who find themselves in such circumstances should immediately contact their instructor and adviser for advice.”

[23 Nov 2014](http://bulletin.engineering.columbia.edu/policy-conduct-and-discipline)
Academic Integrity

What constitutes a breach in academic integrity?

- The following are the most common breaches of academic integrity. When in doubt, ask a professor if you’re unsure if you are breaching academic integrity:
  - Cheating (of any kind)
  - Representing someone else’s work as your own
  - Not giving appropriate credit (citations) of someone else’s work
  - Collaborating on work when permission was not granted
  - Utilizing library or internet sources without giving credit
  - Using a previous assignment or paper from another class or course
  - Selling notes, exam answers or papers
  - Using some else's papers or assignments as your own

[23 Nov 2014](http://gradengineering.columbia.edu/academic-integrity)
[accessed 16 Dec 2014](http://bulletin.engineering.columbia.edu/policy-conduct-and-discipline)
[accessed 16 Dec 2014](http://www.apastyle.org/learn/quick-guide-on-references.aspx)
[accessed 16 Dec 2014](http://www.princeton.edu/pr/pub/integrity/pages/plagiarism/)
[accessed 16 Dec 2014](http://library.columbia.edu/subject-guides/social-sciences/plagiarism.html)
Academic Integrity

• “Plagiarism and Acknowledgment of Sources

Columbia has always believed that writing effectively is one of the most important goals a college student can achieve. Students will be asked to do a great deal of written work while at Columbia: term papers, seminar and laboratory reports, and analytic essays of different lengths. These papers play a major role in course performance, but more important, they play a major role in intellectual development. Plagiarism, the use of words, phrases, or ideas belonging to another, without properly citing or acknowledging the source, is considered one of the most serious violations of academic integrity and is a growing problem on university campuses.”

Academic Integrity

• “Plagiarism and Acknowledgment of Sources (continued)

One of the most prevalent forms of plagiarism involves students using information from the Internet without proper citation. While the Internet can provide a wealth of information, sources obtained from the web must be properly cited just like any other source. If you are uncertain how to properly cite a source of information that is not your own, whether from the Internet or elsewhere, it is critical that you do not hand in your work until you have learned the proper way to use in-text references, footnotes, and bibliographies. Faculty members are available to help as questions arise about proper citations, references, and the appropriateness of group work on assignments. You can also check with the Undergraduate Writing Program. Ignorance of proper citation methods does not exonerate one from responsibility.”

• “Plagiarism and Acknowledgment of Sources (continued)
• Intentional
• Use others’ intellectual work without quotation or reference to the source:
• Type I: Direct Copy & Paste
• Type II: Small Modification by Word Switch
• Type III: Use Others’ Reasoning Style
• Type IV: Use Others’ Metaphor
• Type V: Use Others’ Idea
• Barnbaum, C. “Plagiarism: A Student’s Guide to Recognizing It and Avoiding It.” Valdosta State University.

Examples may be found at the link below:
Academic Integrity

• “Plagiarism and Acknowledgment of Sources (continued)

• Unintentional

• Unintentional plagiarism is plagiarism that results from the disregard for proper scholarly procedures. Examples of Unintentional Plagiarism:
  • Failure to cite a source that is not common knowledge.
  • Failure to "quote" or block quote author's exact words, even if documented.
  • Failure to put a paraphrase in your own words, even if documented.
  • Failure to put a summary in your own words, even if documented.
  • Failure to be loyal to a source.

• “Plagiarism Tutorial. ” Duke University. 
  https://plagiarism.duke.edu/unintent/
Academic Integrity

Common Knowledge and Facts

• “Common knowledge” does not need to provide citation if:
  • An average educated person knows it;
  • It is easy to look up;
  • It can be found from multiple sources.

Example: HIV is the human immunodeficiency virus that causes AIDS.

• “Facts” that do not open to contention do not need to provide citation.

Example: United States of America has 50 states and 1 district.

• Note: ”Common Knowledge” in one academic area might not be “common” for outsiders, so when you are not sure, cite to be safe or ask your professor for help.
EndNote allows users to search, retrieve and store citations from bibliographic databases such as ABI Inform, the Web of Science, Anthropological Literature, the MLA bibliography, or the catalogs of individual libraries. It can generate bibliographies, reading lists, and footnotes in a wide variety of styles, and because it links directly to word-processing programs such as Microsoft Word and Wordperfect, the software enables users to add and format citations to papers as they write.

The Columbia University Libraries purchased an EndNote site license for the Columbia community. You can download the program for free.
### Columbia Chemical Engineering MS Program

<table>
<thead>
<tr>
<th>Fall 2018</th>
<th>Spring 2019</th>
<th>Summer 2019</th>
<th>Fall 2019</th>
</tr>
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<tbody>
<tr>
<td>Sep-Dec 18</td>
<td>Jan-May 19</td>
<td>Jun-Aug 19</td>
<td>Sep-Dec 19</td>
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<tr>
<td>CHEN E4001 Essentials A</td>
<td>Core MS Course</td>
<td>Time for Summer Internships</td>
<td>Core MS Course</td>
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<tr>
<td>CHEN E4002 Essentials B</td>
<td>Core MS Course</td>
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**Goal:**

MS in Chemical Engineering active in the job market

Note: Scientist to Engineer, “S2E”, students must select 1 course with substantial design content

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</table>

1. Core
2. Scientist to Engineer (S2E) Fundamentals
3. Technical Electives
4. Research
5. MS Colloquium
6. Career Placement

MS Degree Requirements: 30 credits beyond BS in chemical engineering
12 credits: graduate core, 18 credits: technical electives
Thesis not required, but Master's Research may be included in the electives.
Example Graduate Core Courses

CHEN E4235x  Surface Reactions & Kinetics
CHEN E4110x  Transport Phenomena III
CHEN E4010x  Math Methods in Chem Eng
CHEN E4130x  Advanced Chem Eng Thermo
or:
CHAP E4120x  Statistical Mechanics

CHEN E4330y  Advanced Chemical Kinetics
CHEN E4110y  Transport Phenomena III
CHEN E4010y  Math Methods in Chem Eng

Note: x indicates Fall, y indicates Spring
MS in Chemical Engineering Graduate Degree Application and Conferral

All MS Students must apply for their degree based on the deadline requirements listed at the Columbia University Office of the Registrar Degree Application Web Site: [http://registrar.columbia.edu/content/graduation-and-diplomas/](http://registrar.columbia.edu/content/graduation-and-diplomas/)

Example: In order to complete your studies in **December 2019** and have the degree conferred in **February 2020**, an MS in Chemical Engineering Student must apply at the before mentioned web site not later than **1 November 2019**. See the web site for a specific deadline. If you do not apply for the degree, you will not be approved to graduate.

You must apply for the degree. You will be notified by the department if something is **wrong** with your status. Degree Audit Reports (DARs) can be **inaccurate**. Go with the word from the Chemical Engineering Department and be on your way to degree success.

Refer all other matters about graduation to GSA, see [http://gradengineering.columbia.edu/graduation-1](http://gradengineering.columbia.edu/graduation-1) And [https://www.cc-seas.columbia.edu/gradzone](https://www.cc-seas.columbia.edu/gradzone)
Typical Program
(Students with a BS in ChE)

Fall, Year 1
CHAP E4120x (Stat Mech)
CHEN E4010x (Math Methods)
technical elective
technical elective
CHEN E9001 MS Colloquium

Spring, Year 1
CHEN E4110y (Transport-III)
CHEN E4330y (Adv Kinetics)
technical elective
technical elective

Fall, Year 2
technical elective
technical elective

CHEN E9001 MS Colloquium is required. All 1st year MS students must register for CHEN E9001.
Possible Program
(Students with a BS in ChE)

Fall
CHAP E4120x (Stat Mech)
CHEN E4010x (Math Methods)
technical elective
technical elective
technical elective
CHEN E9001 MS Colloquium

Spring
CHEN E4110y (Transport-III)
CHEN E4330y (Adv Kinetics)
technical elective
technical elective
technical elective

CHEN E9001 MS Colloquium is required. All 1st year MS students must register for CHEN E9001.
Students without a BS in Chemical Engineering  
Scientist to Engineer (S2E) Program  

An intensive, accelerated consideration of the essential chemical engineering principles from the undergraduate program  

**CHEN E4001x Essentials of Chem Eng – A**  
1. Introduction to Chemical Engineering  
2. Chemical Engineering Control  
3. Transport Phenomena I  
4. Transport Phenomena II  

**CHEN E4002x Essentials of Chem Eng – B**  
1. Thermodynamics I  
2. Thermodynamics II  
3. Reaction Kinetics & Reactor Design  
4. Chemical & Biochemical Separations  

A graduate-level course with substantial design content (also counts as a technical elective)
Arranged to be 6 credits to minimize costs for students, but content/workload far exceed 6 credits: *6 credits cannot count toward MS degree*, so

*S2E students need 36 credits total to graduate*

Each course consists of 4 modules, each taught by different faculty member and covering essentials of an undergraduate course in intensive, accelerated way

Each module will last ~3 weeks and include 6 lectures, 2 recitation classes, 2 homeworks, and an exam
S2E Design Requirement

S2E students must select one of these courses to meet the design course requirement:

Fall
- CHEN E4400x Chemical Process Development

Spring
- CHEN E4501y Chemical Engineering Process Safety

*Take one of these courses after completing CHEN E4001 and CHEN E4002*
Typical Program
(Students in S2E Program)

Fall, Year 1
CHEN E4001x (Essen ChE-A)
CHEN E4002x (Essen ChE-B)
technical elective
technical elective
CHEN E9001 MS Colloquium

Spring, Year 1
CHAP E4130y (Adv Kinetics)
CHEN E4010y (Math Methods)
CHEN E4501y (design elective)
technical elective

Fall, Year 2
CHEN E4330x (Adv Thermo)
CHEN E4110x (Transport-III)
technical elective
technical elective

CHEN E9001 MS Colloquium is required. All 1st year MS students must register for CHEN E9001.
Technical Electives

- Courses at 4000 or 6000 level
- With advisor approval MS students may select up to 6 points of the required 30 from outside the Department.
- May include up to 6 credits of MS Research (CHEN E9400), with written approval of research advisor. (Maximum of 3 points per academic term)
- Should not be equivalent to courses already taken as an undergraduate
- Approved in writing by a graduate program advisor
- Check Alphabetic listing of class times, locations, instructor and course descriptions: [http://www.columbia.edu/cu/bulletin/uwb/](http://www.columbia.edu/cu/bulletin/uwb/)
MS in Chemical Engineering
Concentrations

✓ Science and Engineering of Polymers and Soft Materials
✓ Biochemical Engineering
✓ Electrochemical Engineering and Energy Systems
✓ Process Engineering

<table>
<thead>
<tr>
<th>Time</th>
<th>Course Code</th>
<th>Course Name</th>
<th>Instructor</th>
<th>Credits</th>
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<tbody>
<tr>
<td>8:40am - 9:55am</td>
<td>CHEN E4231 Solar Fuels Esposito</td>
<td>45</td>
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<tr>
<td>10:10am - 11:25am</td>
<td>CHEN E3110 Transport I Boyce</td>
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<td>11:40am - 12:55pm</td>
<td>CHEN E4010 Math Methods Bozic</td>
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<td>1:10pm - 2:25pm</td>
<td>CHEN E4500 Design I Bozic</td>
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<tr>
<td>2:40pm - 3:55pm</td>
<td>CHEN E4140 Separations Durning</td>
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<td>4:10pm - 5:25pm</td>
<td>CHEN E4700 Genomic Technology Ju</td>
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<td>5:40pm - 6:55pm</td>
<td>CHEN E4300 Genomic Technology</td>
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<td>7:00pm - 8:00pm</td>
<td>CHAP E4120 Stat Mech O'Shaughnessy</td>
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</table>

**Note:** The schedule includes both undergraduate and graduate courses, with some sections offered as electives. Faculty Talks are marked with a note to indicate special sessions.
<table>
<thead>
<tr>
<th>Time</th>
<th>Undergraduate</th>
<th>Graduate Core</th>
<th>Graduate Elective</th>
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<td><strong>Monsday</strong></td>
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<td>CHEN E4235 Surface Rxn and Kinetics</td>
<td>CHEN E3110 Transport I</td>
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<td>Boyce (60)</td>
<td>Boyce (60)</td>
<td>Boyce (60)</td>
</tr>
<tr>
<td>11:40am - 12:55pm</td>
<td>CHEN E4010 Math Methods</td>
<td>CHEN E4110 Transport III</td>
<td>CHEN E4110 Transport III</td>
</tr>
<tr>
<td></td>
<td>Bozic (45)</td>
<td>Durning (45)</td>
<td>Durning (45)</td>
</tr>
<tr>
<td><strong>Tuesday</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:10pm - 2:25pm</td>
<td>CHEN E540 Res. Meth.</td>
<td>CHEN E4001 Essentials A</td>
<td>CHEN E4001 Essentials A</td>
</tr>
<tr>
<td></td>
<td>Bishop (20)</td>
<td>Banta (45)</td>
<td>Banta (45)</td>
</tr>
<tr>
<td>2:40pm - 3:55pm</td>
<td>CHEN E3020 Analysis I</td>
<td>CHEN E4002 Essential B</td>
<td>CHEN E4002 Essential B</td>
</tr>
<tr>
<td></td>
<td>West (60)</td>
<td>McNeil (60)</td>
<td>McNeil (60)</td>
</tr>
<tr>
<td>4:10pm - 5:25pm</td>
<td>CHEN E4140 Separations</td>
<td>CHEN E9000 Colloquium</td>
<td>CHEN E4500 Design I</td>
</tr>
<tr>
<td></td>
<td>Durning (60)</td>
<td>4:00pm - 5:00pm</td>
<td>Banta (60)</td>
</tr>
<tr>
<td>5:40pm - 6:55pm</td>
<td>CHEN E4860 NMR</td>
<td>CBN E4860 NMR</td>
<td>CHEN E4860 NMR</td>
</tr>
<tr>
<td>7:00pm - 8:00pm</td>
<td>CHEN E4020 Protection of Industrial Property</td>
<td>CHEN E4700 Genomic Technology</td>
<td>CHEN E4130 Advanced Thermo</td>
</tr>
<tr>
<td></td>
<td>Spall (45)</td>
<td>O’Shaughnessy (60)</td>
<td>O’Shaughnessy (60)</td>
</tr>
<tr>
<td>8:00pm - 9:30pm</td>
<td>CHAP E4120 Stat Mech</td>
<td>CHEN E4700 Genomic Technology</td>
<td>CHEN E4400 Chemical Process Development</td>
</tr>
<tr>
<td></td>
<td>O’Shaughnessy (45)</td>
<td>O’Shaughnessy (60)</td>
<td>Mattas (45)</td>
</tr>
<tr>
<td><strong>Wednesday</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10:10am - 11:25am</td>
<td>CHEN E3110 Transport I</td>
<td>CHEN E4110 Transport III</td>
<td>CHEN E4235 Surface Rxn and Kinetics</td>
</tr>
<tr>
<td></td>
<td>Boyce (60)</td>
<td>Durning (45)</td>
<td>Chen (30)</td>
</tr>
<tr>
<td>11:40am - 12:55pm</td>
<td>CHEN E4010 Math Methods</td>
<td>CHEN E4110 Transport III</td>
<td>CHEN E4235 Surface Rxn and Kinetics</td>
</tr>
<tr>
<td></td>
<td>Bozic (45)</td>
<td>Durning (45)</td>
<td>Chen (30)</td>
</tr>
<tr>
<td><strong>Thursday</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:10pm - 4:00pm</td>
<td>CHEN E4300 Controls A</td>
<td>CHEN E4001 Essentials A</td>
<td>CHEN E4001 Essentials A</td>
</tr>
<tr>
<td></td>
<td>McNeil (60)</td>
<td>Banta (45)</td>
<td>Banta (45)</td>
</tr>
<tr>
<td>4:10pm - 6:55pm</td>
<td>CHEN E4850 Contaminant Site Clean Up</td>
<td>CBN E4860 NMR</td>
<td>CHEN E4400 Chemical Process Development</td>
</tr>
<tr>
<td></td>
<td>(35)</td>
<td>for Bio, Soft, and Energy Materials</td>
<td>Development Mattas (45)</td>
</tr>
<tr>
<td><strong>Friday</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00pm - 9:30pm</td>
<td>CHEN E2100 MEB Banta (60)</td>
<td>CHEN E4020 Essential B</td>
<td>CHEN E4400 Chemical Process Development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>McNeil (60)</td>
<td>Mattas (45)</td>
</tr>
<tr>
<td><strong>Sample S2E Schedule, Fall 2018</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Example Fall Courses in the Department of Chemical Engineering (3 pts each)**

S2E Recitation periods are highlighted in yellow. S2E Students must attend recitation periods, but do not need to register for the CHEN E4001 and CHEN E4002 recitation periods. CHEN E4001 and CHEN E4002 are for S2E students only.

**MECE E4320 will count as in the department.**

*Courses in red count toward the S2E Student design requirement. S2E students must fulfill the design requirement after successful completion of CHEN E4001 and CHEN E4002.*

#S2E students are eligible to take this elective during the first semester and count the course as within the department of chemical engineering.

### Chemical Engineering Graduate Courses Fall 2018

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course title</th>
<th>Day</th>
<th>Start Time</th>
<th>End Time</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHAP E4120#</td>
<td>STAT MECH</td>
<td>T</td>
<td>7:00 PM</td>
<td>9:30 PM</td>
<td>O'Shaughnessy</td>
</tr>
<tr>
<td>CHEN E4001</td>
<td>ESSENTIALS OF CHEM ENG A</td>
<td>TR</td>
<td>1:10 PM</td>
<td>2:25 PM</td>
<td>Banta</td>
</tr>
<tr>
<td>CHEN E4001</td>
<td>ESSENTIALS OF CHEM ENG A R01</td>
<td>F</td>
<td>10:00 AM</td>
<td>11:15 AM</td>
<td>Banta</td>
</tr>
<tr>
<td>CHEN E4002</td>
<td>ESSENTIALS OF CHEM ENG B</td>
<td>TR</td>
<td>2:40 PM</td>
<td>3:55 PM</td>
<td>Banta</td>
</tr>
<tr>
<td>CHEN E4002</td>
<td>ESSENTIALS OF CHEM ENG B R02</td>
<td>F</td>
<td>11:30 AM</td>
<td>12:45 PM</td>
<td>Banta</td>
</tr>
<tr>
<td>CHEN E4010</td>
<td>MATH METHODS</td>
<td>MW</td>
<td>11:40 AM</td>
<td>12:55 PM</td>
<td>Bozic</td>
</tr>
<tr>
<td>CHEN E4020#</td>
<td>PROTECT INTEL PROP</td>
<td>M</td>
<td>7:00 PM</td>
<td>9:30 PM</td>
<td>Spall</td>
</tr>
<tr>
<td>CHEN E4670#</td>
<td>CHEMICAL ENGINEERING DATA ANALYSIS</td>
<td>M,W</td>
<td>10:10 AM</td>
<td>11:25 AM</td>
<td>Bishop</td>
</tr>
<tr>
<td>CHEN E4110</td>
<td>TRANSPORT III</td>
<td>TR</td>
<td>11:40 AM</td>
<td>12:55 PM</td>
<td>Durning</td>
</tr>
<tr>
<td>CHEN E4130</td>
<td>ADV CHEM ENG THERMO</td>
<td>W</td>
<td>7:00 PM</td>
<td>9:30 PM</td>
<td>O'Shaughnessy</td>
</tr>
<tr>
<td>CHEN E4231#</td>
<td>SOLAR FUELS</td>
<td>MW</td>
<td>8:40 AM</td>
<td>9:55 AM</td>
<td>Esposito</td>
</tr>
<tr>
<td>CHEN E4235</td>
<td>SURFACE REACTIONS AND KINETEICS</td>
<td>TR</td>
<td>10:10 AM</td>
<td>11:25 AM</td>
<td>Chen</td>
</tr>
<tr>
<td>CHEN E4400</td>
<td>CHEMICAL PROCESS DEVELOPMENT</td>
<td>R</td>
<td>7:00 PM</td>
<td>9:30 PM</td>
<td>Mattas</td>
</tr>
<tr>
<td>CHEN E4700#</td>
<td>PRINCIPLES OF GENOMIC TECH</td>
<td>W</td>
<td>7:00 PM</td>
<td>9:30 PM</td>
<td>Ju</td>
</tr>
<tr>
<td>CHEN E4850</td>
<td>CONTAMINTED SITE CLEAN UP</td>
<td>R</td>
<td>4:10 PM</td>
<td>6:40 PM</td>
<td>Tsiamis</td>
</tr>
<tr>
<td>CHEN E4680#</td>
<td>NMR FOR BIO, SOFT &amp; ENERGY MATERIALS</td>
<td>M,W</td>
<td>5:40 PM</td>
<td>6:55 PM</td>
<td>Marbella</td>
</tr>
<tr>
<td>CHEN E9001</td>
<td>MASTERS COLLOQUIUM</td>
<td>F</td>
<td>2:10 PM</td>
<td>3:25 PM</td>
<td>Bozic</td>
</tr>
</tbody>
</table>
These are Common Elective Courses Outside of the Department of Chemical Engineering (With advisor approval.
MS students may select up to 6 points of the required 30.)

**Other Electives of Interest to Chemical Engineering Graduate Students**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Days</th>
<th>Start Time</th>
<th>End Time</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECE E4211</td>
<td>ENERGY SOURCES AND CONVERSION</td>
<td>M</td>
<td>4:10 PM</td>
<td>6:40 PM</td>
<td>Modi</td>
</tr>
<tr>
<td>MECE E4320**</td>
<td>INTRO TO COMBUSTION</td>
<td>R</td>
<td>4:10 PM</td>
<td>6:40 PM</td>
<td>Burke</td>
</tr>
<tr>
<td>EAEE E4003</td>
<td>INTRO TO AQUATIC CHEMISTRY</td>
<td>MW</td>
<td>10:10 AM</td>
<td>11:25 AM</td>
<td>Ngai</td>
</tr>
<tr>
<td>EAEE E4163</td>
<td>SUSTAINABLE WATER TREATMENT</td>
<td>M</td>
<td>4:10 PM</td>
<td>6:40 PM</td>
<td>Becker</td>
</tr>
<tr>
<td>EAEE E4550</td>
<td>CATALYSIS OF EMISSIONS CONTROL</td>
<td>MW</td>
<td>2:40 PM</td>
<td>3:55 PM</td>
<td>Farrauto</td>
</tr>
<tr>
<td>EAEE E6212#</td>
<td>CARBON SEQUESTRATION</td>
<td>W</td>
<td>4:10 PM</td>
<td>6:00 PM</td>
<td>Park</td>
</tr>
<tr>
<td>BMEN E4001</td>
<td>QUANTITATIVE PHYSIOLOGY I</td>
<td>MW</td>
<td>8:40 AM</td>
<td>9:55 AM</td>
<td>Kam</td>
</tr>
<tr>
<td>BMEN E4501</td>
<td>TISSUE ENGINEERING I</td>
<td>MW</td>
<td>11:40 AM</td>
<td>12:55 PM</td>
<td>Hess</td>
</tr>
<tr>
<td>APAM E4260</td>
<td>Electrochemical Materials and Devices</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**S2E Recitation periods are highlighted in yellow. S2E Students must attend recitation periods, but do not need to register for the CHEN E4001 and CHEN E4002 recitation periods. CHEN E4001 and CHEN E4002 are for S2E students only.**

**MECE E4320 will count as in the department.**

**Courses in red count toward the S2E Student design requirement. S2E students must fulfill the design requirement after successful completion of CHEN E4001 and CHEN E4002.**

**S2E students are eligible to take this elective during the first semester and count the course as within the department of chemical engineering.**
# CHEN Dept Course Offerings, Spring 2018

## Undergraduate Courses

### Monday
- **8:40am - 9:55am**
  - CHEN E3120 Transport II
    - Bishop (60)
  - CHEN E4650 Polymer Physics
    - Kumar (45)
  - CHEN E4330 Advanced Kinetics
    - Esposito (45)

### Tuesday
- **8:40am - 9:55am**
  - CHEN E3120 Transport II
    - Bishop (60)
  - CHEN E3210 Thermodynamics
    - Obermeyer (45)
  - CHEN E4650 Polymer Physics
    - Kumar (45)

### Wednesday
- **8:40am - 9:55am**
  - CHEN E3120 Transport II
    - Bishop (60)
  - CHEN E4650 Polymer Physics
    - Kumar (45)
  - CHEN E4330 Advanced Kinetics
    - Esposito (45)

### Thursday
- **8:40am - 9:55am**
  - CHEN E3210 Thermodynamics
    - Obermeyer (45)

## Graduate Core Courses

### Monday
- **10:10am - 11:25am**
  - CHEN E4620 Introduction to Polymers
    - Durning (45)
  - CHEN E4600 Atmospheric Aerosols
    - McNeill (45)
  - CHEN E4230 Reaction Kinetics and Reactor Design
    - Chen (45)
  - CHEN E4010 Math Methods
    - Venkat (45)

### Tuesday
- **1:10pm - 2:25pm**
  - CHEN E4501 Safety
    - Bozic (50)

### Wednesday
- **1:10pm - 3:40pm**
  - CHEN E4325 Bioseparations
    - Hartounian (35)

### Thursday
- **4:10pm - 6:40pm**
  - CHEN E8100 Topics in Biology
    - O'Shaughnessy (20)

### Friday
- **4:10pm - 6:40pm**
  - CHEN E4890 Biopharmaceutical Product Development
    - Hug (50)

## Graduate Elective Courses

### Monday
- **11:40am - 12:55pm**
  - CHEN E4110 Transport III
    - Durning (45)

### Tuesday
- **2:40pm - 3:55pm**
  - CHEN E3810 Lab
    - Ju (60)

### Wednesday
- **4:10pm - 6:40pm**
  - CHEN E9000 Colloquium
    - Esposito (50)

### Thursday
- **4:10pm - 6:40pm**
    - Boyce (35)

### Friday
- **5:40pm - 6:55pm**
    - Boyce (35)
### Chemical Engineering Graduate Courses Spring 2018

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course title</th>
<th>Day(s)</th>
<th>Start Time</th>
<th>End Time</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEN E4010</td>
<td>Math Methods in Chemical Engineering</td>
<td>TR</td>
<td>10:10 AM</td>
<td>11:25 AM</td>
<td>Venkatsubramanian</td>
</tr>
<tr>
<td>CHEN E4110</td>
<td>Transport III</td>
<td>MW</td>
<td>11:40 AM</td>
<td>12:55 PM</td>
<td>Durning</td>
</tr>
<tr>
<td>CHEN E4150</td>
<td>Computational Fluid Dynamics in Chem Eng</td>
<td>MW</td>
<td>5:40 PM</td>
<td>6:55 PM</td>
<td>Boyce</td>
</tr>
<tr>
<td>CHEN E4325</td>
<td>Bioseparations</td>
<td>R</td>
<td>1:10 PM</td>
<td>3:40 PM</td>
<td>Hartounian</td>
</tr>
<tr>
<td>CHEN E4330</td>
<td>Adv Chemical Kinetics</td>
<td>TR</td>
<td>8:40 AM</td>
<td>9:55 AM</td>
<td>Esposito</td>
</tr>
<tr>
<td>CHEN E4501</td>
<td>Chemical Engineering Process Safety</td>
<td>TR</td>
<td>1:10 PM</td>
<td>2:25 PM</td>
<td>Bozic</td>
</tr>
<tr>
<td>CHEN E4600</td>
<td>Atmospheric Aerosols</td>
<td>MW</td>
<td>10:10 AM</td>
<td>11:25 AM</td>
<td>McNeill</td>
</tr>
<tr>
<td>CHEN E4620</td>
<td>Intro to Polymers</td>
<td>MW</td>
<td>10:10 AM</td>
<td>11:25 AM</td>
<td>Durning</td>
</tr>
<tr>
<td>CHEN E4650</td>
<td>Polymer Physics</td>
<td>MW</td>
<td>8:40 AM</td>
<td>9:55 AM</td>
<td>Kumar</td>
</tr>
<tr>
<td>CHEN E4740</td>
<td>Bio-Transport and Rate Phenomena II</td>
<td>TR</td>
<td>2:40 PM</td>
<td>3:55PM</td>
<td>Leonard</td>
</tr>
<tr>
<td>CHEN E4890</td>
<td>Biopharmaceutical Product Development and Chemical Engineering</td>
<td>R</td>
<td>4:10 PM</td>
<td>6:40 PM</td>
<td>Hartounian</td>
</tr>
<tr>
<td>CHEN E8100</td>
<td>Topics in Biology</td>
<td>R</td>
<td>4:10 PM</td>
<td>6:40 PM</td>
<td>O'Shaughnessy</td>
</tr>
</tbody>
</table>

*Courses in red count toward elective requirement for S2E students*
Example Spring 2018 Electives in the Department of Chemical Engineering (3 pts each)

These are Common Elective Courses Outside of the Department of Chemical Engineering (With advisor approval MS students may select up to 6 points of the required 30.)

<table>
<thead>
<tr>
<th>Cross-Listed Courses</th>
<th>Chemical Engineering &amp; Earth/Environmental Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEE E6252</td>
<td>ADV SURFACE/COLLOID CHEMISTRY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Electives of Interest to Chemical Engineering Graduate Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>MECE E4210</td>
</tr>
<tr>
<td>MECE E4302</td>
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</table>

<table>
<thead>
<tr>
<th>Earth/Environmental Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAEE E4150</td>
</tr>
<tr>
<td>EAEE E4160</td>
</tr>
<tr>
<td>EAEE E6150</td>
</tr>
</tbody>
</table>

*Courses in red count toward the S2E Student design requirement. S2E students must fulfill the design requirement after successful completion of CHEN E4001 and CHEN E4002*
MS Student Course Registration/Advising

Graduate student must register during the designated registration period or risk loss of student status. Registration for classes is done through student services on line: https://ssol.columbia.edu/ Graduate student course registration dates are dictated by the CU Registrar Office and posted at the Columbia Academic Calendar site. http://registrar.columbia.edu/event/academic-calendar

“Advising of MS students is currently the responsibility of the Masters Committee. Each incoming MS student will be assigned an advisor who will approve courses.” (2015-2016 Columbia Chemical Engineering Graduate Student Handbook: http://cheme.columbia.edu/masters-program-2)

MS student advising takes place close to the registration period. Typical advising weeks are the week prior to classes starting for entering students and the week prior to the academic calendar registration dates for each subsequent Spring or Fall semester. Students will be informed of advising dates via Columbia email. Students are required to meet with their academic advisor during that time. Students are informed at orientation of core and suggested elective courses. All course selections must be approved by an academic advisor. Student will be informed of course options via email or other means for subsequent semesters.
Prior to meeting with an academic advisor, an MS student must record all current and requested courses and grades on the academic advising sheet in order to inform the advisor of the current program structure. This is done to save the student time as evaluation of student progress in the program is needed prior to making changes. See example advising sheet below:

<table>
<thead>
<tr>
<th>Name and UNI</th>
<th>courses, points, and all available grades</th>
</tr>
</thead>
</table>

Fill out this form any time you request for a change to classes.

This form may be obtained at: [http://cheme.columbia.edu/ms-advising](http://cheme.columbia.edu/ms-advising)
“What should I do when I register in SSOL and the course that I have chosen is listed as “full” in SSOL?
If you find that the course you have chosen is full when you try to register, you may enter your name on the wait list (See Aurna Malakar in the Department of Chemical Engineering for “Wait Lists”) for that course and then wait and see if a slot opens up. It is suggested that you attend the first few lessons of the course so that if you come off the wait list, you will not be behind on the material. You may choose to contact the professor about availability in the course. **You must have a backup plan as if the course is full you may not be able to take it at the semester of offering and thus you must take another course.** Your academic plan must be agreed upon between you and your academic advisor. Any changes made to your academic plan must be approved in writing by your academic advisor. Any back up courses need to be approved by your academic advisor so that you meet all graduation requirements. You must manage this request for change carefully.”

http://cheme.columbia.edu/masters-program-faq#AD004
Chemical Engineering Department Colloquia

CHEN 9000x/y Chemical Engineering Colloquium

- Tuesdays 4PM *(check the website for the schedule before attending)*
  cheme.columbia.edu/colloquia

- Attendance is **optional** for MS students
MS Colloquia

CHEN E9001 Masters Colloquium
(Fall Semester Only):

• Fridays 2:10PM-3:25PM
• Guest lecturers from Industry, including alumni, adjunct faculty, etc

• All first year MS students must register for CHEN E9001.

• Attendance Requirement: All first year MS Students must attend MS Colloquium.

“Colloquia definition, a conference at which scholars or other experts present papers on, analyze, and discuss a specific topic.” dictionary.com accessed 1 Mar 2018
Learn about careers in industries that require technical expertise in chemical engineering. (Obj 1)

Understand more about the impact of engineering solutions in a global, economic, environmental, and societal context. (Outcome 8)

Develop an understanding of professional and ethical responsibility (Outcome 6)

Enhance knowledge of contemporary issues. (Outcome 10)

American Institute of Chemical Engineers Young Professionals

Historical Perspective of Chemical Engineering

Chemical Engineering in the Pharmaceutical Industry

The Engineer in the Catalyst Industry

Strengthen your foundation to pursue alternative career paths, especially careers in business, management, finance, law, medicine or education. (Obj 4)

Learn about and recognize the need for, and ability to engage in life-long learning. (Outcome 9)
Applying to the Ph.D. Program

- Must formally apply if you are interested
- No guarantees; in competition with all other applicants
- Opportunity to impress faculty with grades and/or performance in a research group
- You will also be well prepared for doctoral programs in other universities
Experienced industry professionals who teach focused courses
Masters Committee

Robert G. Bozic

Aaron Moment

Scott A. Banta

Responsible for approving programs
Chemical Engineering Staff

Rezarta Binaj
Business Manager

Kathy Marte
Director of Finance and Operations

Ariel Sanchez
IT Manager

Irina Khenkin
Career Placement Officer

Aurna Malakar
Operations Manager
Faculty Research Themes

• Catalysis
• Molecular Dynamics
• Polymers/Materials
• Electrochemical Engineering
• Biological & Medical Engineering
• Informatics & Large Data Systems
• Sustainable Energy & the Environment

Non-Research Themes

• Chemical Product Design
• Chemical Process Engineering
Joining a Research Group

- Not required of MS Students
- Maximum of 3 points per semester.
- Maximum of 6 points towards the degree.
- Research course may be selected for the second and/or the third semester
- Take advantage of Chem Eng Poster sessions
- Approach faculty and express interest in the research
- Limited number of opportunities, and you will be in competition with other students, so sell yourself!
Columbia ChemE Grad Student Life

“Welcome to CU ChemE BBQ!” Aug 2014

MS Program Orientation Aug 2014
Chemical Engineering Graduate Organization (CheGO)

Organization Functions

1. Act as a liaison between the graduate student population and the department on issues of concern to the student body

2. Organize and run activities which enrich the academic and social experience of graduate students within the department

3. Assist in the management of the newly created chemical engineering community outreach program

4. Aide in the planning and running of miscellaneous departmental activities (e.g., open house, orientation, graduate student breakfasts, etc.)
ChemE Community Outreach

- Fredrick Douglas Academy II located Harlem, NY
- In class experiments and lectures with middle school and high school students
- Mentoring and judging a science fair

(Knehr, Kevin MS Colloquium 5 Sep 2014)
ChemE Community Outreach

- Monthly breakfasts for graduate students, faculty and staff
- Happy hours and social events with other departments
- Hosted the NYC Intercollegiate Chemistry and Chemical Engineering (NICChE) Conference
- Young professor/professional talks with Q & A discussions
Some Student Organizations of Campus

• Engineering Graduate Student Council (EGSC)
• American Institute of Chemical Engineers (AIChE)
• Association for Computing Machinery (ACM)
• American Society of Civil Engineers (ASCE)
• American Society of Mechanical Engineers (ASME)
• Columbia Science Review (CSR)
• American Institute of Aeronautics and Astronautics (cuAIAA)
• Engineers Without Borders (EWB)
• Entrepreneurship, Leadership and Consulting Club
• Institute of Electrical and Electronics Engineers (IEEE)
• Society of Automotive Engineers (SAE)
• Scientists & Engineers for a Better Society (SEBS)
• Society of Women Engineers (SWE)
Career Placement

All first year MS students must complete career placement requirements.

- Resume Writing
- Business Writing
- Networking
- Interviewing

Your Career Placement Requirements

Engineering School Career Fair

Direct all questions regarding career placement requirements to the Career Placement Officer, Irena Khenkin, ik2380@columbia.edu, (work phone) 212-854-9158.
New York City Advantage

- Campus in the Morningside Heights neighborhood of Manhattan
- NYC: major player in high-tech research & development, financial and other industries
- Vibrant Columbia alumni network
- Long tradition of collaboration with private industry and public sector

internships, networking, job search
Employers

• Accenture
• Amex
• Apple
• Bain Capital
• Bain & Company
• Bank of America
• Barclays Capital
• Bloomberg
• BNP Paribas
• Boeing
• Boston Consulting Group
• Booz Allen
• BP
• Chevron
• Credit Suisse
• Dell

• Deutsche Bank
• EMC
• Exxon
• Fedex
• General Electric
• Goldman Sachs
• Google
• HSBC
• HP
• IBM
• ITT Corp
• Johnson & Johnson
• JP Morgan
• Louis Vuitton
• Mars
• Mayo Clinic

• McKinsey & Co.
• Microsoft
• Morgan Stanley
• Murex
• NASA
• Pfizer
• Proctor & Gamble
• RBS
• SocGen
• Texas Instruments
• UBS
• United Nations
• United Technologies
• Walmart
• Yahoo
• and many more....

*Data from Graduation Exit Survey for School of Engineering*
Housing

• University Apartment Housing (UAH)
  http://facilities.columbia.edu/housing/

• International House
  http://www.ihouse-nyc.org

The Off-Campus Housing Assistance Office (OCHA)-
http://www.columbia.edu/cu/ire/ocha/

Alternative Housing List:
Contact The Office of Graduate Student Services
“NOCELAC!”

“No One Can Engineer Like A Columbian”
Back Up Slides Start Here

http://cheme.columbia.edu/
http://gradengineering.columbia.edu/frequently-asked-questions-2