



RENSSELAER POLYTECHNIC INSTITUTE

School of Engineering

**Chemical &
Biological
Engineering**

HANDBOOK

Fall 2016

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Department of Chemical & Biological Engineering

<http://cbe.rpi.edu/>

The major educational objective in the Howard P. Isermann Department of Chemical and Biological Engineering is to prepare students to enter their engineering practice dealing with chemical as well as physical processes to meet the challenges for the future. The curriculum, which builds on chemistry, biology, mathematics, basic sciences, and engineering science, culminates in professional applications in which theory is tempered by engineering art and economic principles. Through this curriculum, graduates are prepared equally well for professional practice or for advanced study.

Opportunities for creative and satisfying practice in chemical and biological engineering can be found in conception, design, control, or management of processes involving chemical and/or biochemical transformations. These processes range from the more conventional conversion of crude oil into petrochemicals and plastics, to the development of novel processes for the production of biopharmaceuticals, to the creation of lab on chip devices using nanomaterials. The chemical conversion of resources into new, more useful forms has been the traditional concern of chemical engineers. In recent years there has developed a critical concern with the depletion of resources, leading to increased efforts to conserve, recycle, and find alternatives. Concurrently with high-technology advances in biochemical and semiconductor processing, these developments pose challenges that fall on the chemical engineering profession.

An undergraduate degree that works! Our chemical engineering graduates are well prepared for advanced graduate study and for professional practice. The companies employing Rensselaer chemical engineering graduates during the past decade are;

- Amgen (biopharmaceuticals), BioGen-IDG (biopharmaceuticals),
- Centocor (biopharmaceuticals), ExxonMobil (oil and chemicals),
- General Electric (plastics, energy), Human Genome Sciences (biopharmaceuticals),
- IBM (semiconductors), Intel (semiconductors),
- Genzyme (pharmaceuticals) Millipore (biopharmaceuticals),
- Merck (pharmaceuticals), Momentive (specialty chemicals)
- Procter & Gamble (consumer goods) Regeneron (pharmaceuticals)
- Sanofi (pharmaceuticals) Schlumberger (petroleum)

Diverse career choices exist not only in the chemical industry, but in virtually all processing industries, including agricultural, biotechnology, biomedical, chemical, food, nuclear, semiconductor processing, and environmental operations. By emphasizing basic principles, the program prepares its graduates for positions spanning the spectrum of activities from research and development, to process and project engineering, to production, or to technical marketing. Chemical engineering also provides an excellent background for entering medical school and law school.

Contact List for ChBE

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General Links:

Fall 2016 Class Hour Schedule: <http://sis.rpi.edu/stuclshr.htm>

Registrar Forms: <http://registrar.rpi.edu/update.do?catcenterkey=29>

Student Information System: <http://sis.rpi.edu/>

Advising and Learning Assistance Center: <http://alac.rpi.edu/>

Center for Career & Professional Development: <http://www.rpi.edu/dept/cdc/>

Co-Ops: <http://www.rpi.edu/dept/cdc/students/experience/coop/>

Internships: <http://www.rpi.edu/dept/cdc/students/jobsearch/summer.html>

Dean of Students - Student Handbook: <http://doso.rpi.edu/>

Objectives of the ChBE Undergraduate Curriculum

Within five years of graduation, Alumni of the Howard P. Isermann Department of Chemical and Biological Engineering will be:

- Gainfully employed in a professional capacity and promoting the responsible application of technology to enhance the common good.
- Preparing for leadership roles in society by furthering their proficiency in engineering practice or by preparing for professional practice in related disciplines via further graduate or professional study.

Responsibilities

Student's responsibilities

- To know their advisor's office hours and advising schedule.
- To make an appointment and prepare for registration advising by reviewing the Catalog, Class-Hour Schedule, and Curriculum Advising & Program Planning (CAPP) Program.
- To formulate questions regarding curriculum, course selections, career options, etc.
- To be aware of their academic and personal needs and to seek assistance when needed.
- To understand that the role of their advisor is to advise them, not to make decisions for them. Each student needs to realize that it's his or her education at stake, and that, with advisement, *they* are ultimately responsible for making any final decisions.

Advisor's responsibilities

- To be accessible to students throughout the year at posted office hours. If an advisor will be away from campus for an extended period of time, he or she should post the names and office locations of alternate advisors outside their offices, so that students will have other advising resources.
- To set aside designated times for registration advising and individual discussions.
- To be knowledgeable about current curriculum requirements, academic policies and procedures, referrals and resources on campus, and career opportunities in the major field.
- To guide students through academic programs that will complement their personal, educational, and professional interests.

Bachelor's Degree

The bachelor's degree is awarded to students who have pursued successfully, as evaluated by the faculty, a plan of study that encompasses several disciplines. Each plan of study has at least two objectives: first, to reach a pre-professional standing or fundamental mastery in a selected discipline; second, to develop some grounding in knowledge found in liberally educated persons, an appreciation of technology and science, and openness to ongoing learning.

The requirements of each baccalaureate program are outlined as follows:

- The number of courses and credit hours is prescribed by each curriculum. Minimum requirements are typically 124 credit hours for science, for humanities and social sciences majors and for management, **128 for engineering**, and 168 for the professional degree in the School of Architecture.
- The minimum grade point average (GPA) is **2.00**.
- To receive a baccalaureate degree, a student must have been admitted to the curriculum corresponding to the degree, must have satisfied the curriculum requirements, and must be enrolled in that curriculum at the time the degree is granted.
- The course content in physical, life, and engineering sciences must total a minimum of **24 credit hours**, including at least **eight credit hours** of mathematics. For information on additional requirements see the School of Science section of the course catalog.
- The course content in humanities and social sciences must total a minimum of **24 credit hours**, including at least **eight credit hours** in the humanities and **eight credit hours** in the social sciences. For information on additional requirements see the School of Humanities, Arts, and Social Sciences section of the course catalog.
- Every student is required to take at least **two** communication-intensive courses. At least one of these must be in the students' major and at least one of the courses must be writing intensive and taught in the School of Humanities, Arts, and Social Sciences.
- The minimum course concentration in the area of the selected discipline is prescribed by each curriculum but **cannot be less than 30 credit hours**.
- At least **24 credit hours are to be elective**, of which no less than **12 credit hours** are unrestricted electives.
- The student must be registered full-time for a minimum of four semesters. Two semesters of part-time study at Rensselaer will be considered equivalent to one semester of full-time study. In addition, the student must complete a minimum of **64 credit hours** at Rensselaer, all of which will be applied to the bachelor's degree. If a transfer student elects to study abroad or enroll in the co-op program, no more than 12 such credits may apply to the 64 needed for the bachelor's degree. The student's Plan of Study at Rensselaer must include at least 16 credits of courses above the 1000 level in the major field, or in an approved concentration.

Academic Information and Regulations

The Institute requires a degree candidate to earn the last 30 credits in courses completed on this campus or through a program formally recognized by the Institute. Transfer courses are limited to two courses or eight credits counting toward the student's last 30 credits and require approval of the director of the Advising and Learning Assistance Center.

Baccalaureate candidates must have passed all of the prescribed academic work and have satisfied the fee requirements. Candidates must also be in good academic and disciplinary standing. Undergraduate students on probation at the time of completion of course work may be required to meet certain stipulations for removal from probation. However, such requirements may be waived for those students whose cumulative GPAs satisfy the baccalaureate degree requirements. In general, a C average or above will be required in programs arranged by the Committee on Academic Standing. The director of the Advising and Learning Assistance Center will state requirements to the students in writing.

Degree candidates must be registered during the semester in which they intend to graduate and must file a degree application with the registrar by the dates specified in the academic calendar. Students who previously applied for graduation but did not complete all their requirements on time must submit a new application specifying the new date of graduation.

Double Degrees

A student may become a candidate for a second baccalaureate degree when he or she has completed: (1) the equivalent of at least two terms (30 credit hours) of additional work beyond the requirements of a single degree, and (2) the courses in the department in which the student is registered and such other courses as are required for the second degree. From the ChBE department's perspective, students considering a Double Degree may want to instead consider a Co-terminal or regular Master's degree. The ability to obtain a graduate level degree by taking 30 credits beyond the Bachelor's degree should be seriously considered rather than taking 30 additional credits and still ending up with a Bachelor's degree.

Dual Majors

Undergraduate students who fulfill all the degree requirements for two curricula and who have met the conditions below will have completed a dual major. They will receive one diploma noting both majors. (1) The student must designate a first-named and second-named major in writing at least one semester prior to graduation, and have the appropriate department(s) approve this designation prior to filing the dual major form with the registrar. (2) Each student will be assigned an advisor in each department who will monitor progress towards degrees in that department. (3) The degree clearance officer in the department will certify that the student has met the degree requirements in that department. (4) The 24-credit-hour mathematics/science requirement and the 24-credit-hour humanities and social sciences requirement will satisfy the Institute requirements for both majors.

Academic Minors

Due to the undergraduate degree requirements of Chemical and Biological Engineering, the program does not offer minors to students from other disciplines.

The HUB

The SoE Student Services HUB is a great place for freshmen and sophomore engineering students to find answers to their most pressing academic and career related questions. The HUB is located in the Ansell Lounge on the third floor in the Jonsson Engineering Center (JEC). The HUB is comprised of experienced faculty and staff members who specialize in many of the different engineering majors. The HUB is open weekdays during the academic year during the following hours:

Monday-Friday 10:00-4:00

HUB personnel have been trained to answer questions regarding all engineering majors, including required courses, prerequisites, different concentrations, optimal time for co-ops and internships, traveling abroad, etc. We especially encourage undeclared engineering students to utilize The Hub as a resource while they decide what major to pursue. Each personnel member will have access to students' CAPP reports and will be able to supply the student with the best advice, or refer them to a more knowledgeable source. HUB personnel will not be able to sign Student-Advisor Meeting (Sam) requirements for students. Their job is to supplement, not replace, the student's appointed academic advisor.

H&SS and PD II – Policies for Engineering Students

Engineering students at Rensselaer are required to successfully complete

- 20 credits of H&SS (Humanities and Social Sciences)
- 2 credits of PD II (Professional Development II)

as well as

- 1 credit of PD I (typically as part of ENGR-2050 Introduction to Engineering Design, or alternatively as ENGR-1010 Professional Development I if ENGR-2050 transferred in as less than a 4 credit course)
- 1 credit of ENGR-4010 PD III

for a total of 24 credits to fulfill the H&SS Core requirement.

ENGINEERING STUDENTS SHALL DISTRIBUTE THE 20 CREDITS OF H&SS AS FOLLOWS.

- ≥ 8 credits of H (ARTS, COMM, IHSS, LANG, LITR, PHIL, STSH, WRIT)
- ≥ 8 credits of SS (COGS, ECON, IHSS, PSYC, STSS)
- ≥ 4 credits at the 4000+ level
- ≤ 3 courses at the 1000 level (note depth sequence restriction below)
- ≤ 4 credits from 1-credit courses (e.g., music ensembles)
- ≤ 6 credits as pass/no-credit (note depth sequence and CI restrictions below)
- ≤ 2 courses (8 credits maximum) as transfer courses (including AP courses)

a depth sequence of two courses, each of ≥ 4 credits, from the same area code (ARTS, COMM, etc., but not including IHSS) where a minimum of one course (≥ 4 credits) is at an advanced level (2000+), and no courses are taken on a Pass/No Credit basis. STSS and STSH count as the same area code.

In addition, students are required to take at least one H&SS course that is “CI” (Communications Intensive – a list of these courses is available from a link on the SIS home page, and here: <http://registrar.rpi.edu/update.do?artcenterkey=208>). This course may not be taken on a Pass/No Credit basis. This CI course is not required to be part of the 24 credits of H&SS Core; that is, it may instead be an HASS CI course taken as a free elective

Enrolled Rensselaer students wishing to take an H&SS course for credit at another accredited institution must obtain prior approval for the course from the H&SS Manager of Student Services. Applicants must furnish a syllabus (preferred) or the catalog description of the proposed course and a completed copy of Rensselaer’s Transfer Credit Approval form to the H&SS Manager of Student Services to apply for approval.

Cross-listed STSS/STSH courses can be switched (between H and SS) after the course is taken by making a request to the Assistant Registrar.

THE 2-CREDITS OF PD II SHALL BE SATISFIED AS FOLLOWS.

Either of the 2-credit courses, PSYC-4170 or STSS-4840, will satisfy the PD II requirement. **At some future time these will transition to a single 2-credit IHSS-4xxx course that will satisfy the PD II requirement.** Only **one** of these 2-credit PD II courses can be taken for credit.

A 4-credit PD II alternate course at any level (1000-4000) can be substituted for the 2-credit course. A list of these PD II alternate courses is available from a link on the SIS home page, and here: <http://registrar.rpi.edu/update.do?artcenterkey=325>.

A course used to satisfy the PD II requirement may **not** be taken on a Pass/No Credit basis.

In general, the PD II alternate course will be split as follows:

- two credits allocated to satisfy PD II
- the remaining credits allocated to free elective (or “Not Applied” to the degree if free elective credits have been completed)

With restrictions, the credits of a PD II alternate that are not allocated to PD II may be used to fulfill the 20-credits of H&SS. These credits:

- can **not** count toward the 4000 requirement,
- can **not** count toward the depth requirement,
- can **not** increase the number of 1000 level credits past 12.

However,

- they can count toward the overall 20 credits of H&SS,
- they can count toward the H and SS 8-credit minimums,
- they can count toward the H&SS “CI” requirement.

If a student transfers in a course that is in name and course number equivalent to a PD II alternate, it counts as that named HASS course, but it does **not** transfer in its status as a PD II alternate. The student would still be responsible for taking PD II or a PD II alternate at Rensselaer.

In the rare case that a student transfers in a course with Professional Development II content nearly identical to that in either PSYC-4170 or STSS-4840 (the 2-credit PD II courses), they may furnish a syllabus (preferred) or the catalog description of the transfer course and a completed copy of Rensselaer’s Transfer Credit Approval form to the Associate Dean of Engineering to apply for approval. Note that some courses in the Study Abroad program automatically satisfy the PD II requirement, as indicated in the transfer equivalency guide.

The School of Humanities, Arts, and Social Sciences (HASS) Associate Dean of Academic Affairs is:

Mike Kalsher (kalshm@rpi.edu, Sage 4302)

The Assistant Registrar is: Kim Herkert (herkek@rpi.edu, Academy Hall 2713)

The Associate Dean of Engineering is Kurt Anderson (anderk5@rpi.edu, JEC 3018)

Need an Extra Credit?

Q: What if I'm 1-2 credits short in H&SS?

A: Use a 4-credit PD II alternate, with 2 credits to PD II, 1-2 credits to H&SS as needed, and any remaining credits to free elective (or "Not Applied" if you have filled all of your free elective credits)

Q: What if I'm short 1-2 credits in Free Electives?

A: Use a 4-credit PD II alternate, with 2 credits to PD II and 2 credits to free elective

Q: Am I really free to choose my free electives?

A: Almost, but not quite – there are restrictions for "free" electives. To count as a free elective, one credit classes must be either

- from the School of Engineering, or
- graded classes (though you can take these on a Pass/No Credit basis),

and

- ROTC courses (USAF, USAR, USNA) must not total more than six credits

One credit classes that are graded Satisfactory / Unsatisfactory (S/U) that are not in the School of Engineering may **not** be used as free electives. For example, PHYS-1010 A Passion for Physics is a 1-credit S/U course that will not count as a free elective.

Options for 1 credit free electives

- independent study (1 credit \approx 3 hours/week \Rightarrow \sim 45 hours of work)
- undergraduate research project (when taken for credit)
- School of Engineering courses, such as
 - CHME-1010 Introduction to Chemical Engineering
 - CIVL-1100 Introduction to Civil and Environmental Engineering
 - CIVL-1960 / ENVE-1960 AutoCAD CIVL 3D
 - ENGR-1300 Engineering Processes (if not required for your major)
 - ENGR-4962 Fortran Programming
 - ISYE-1100 Introduction to Industrial and Systems Engineering
 - MANE-1100 Introduction to Nuclear Engineering
 - MANE-2961 Mechatronics Hardware and Software
 - MTLE-1200 Introduction to Materials Engineering
- School of Science courses
 - ISCI-4510 Origins of Life Seminar (requires Junior standing or higher)
- HASS courses
 - ARTS-2300 Rensselaer Orchestra
 - ARTS-2310 Rensselaer Concert Choir
 - ARTS-2320 Percussion Ensemble
 - ARTS-2330 Jazz Ensemble
 - ARTS-2960 Ensemble Congeros
- ROTC courses (USAF, USAR, USNA, up to six credits maximum)
- most one-credit topics courses (see <http://srfs.rpi.edu/update.do?artcenterkey=305>)

Chemical & Biological Engineering Curriculum Checklist

Class of 2020

NAME: _____

E-mail: _____

Fall 2016				Spring 2017			
CHME-1010	Intro to Chemical Engineering ¹	1		BIOL-1010 & 1015	Intro to Biology & Laboratory	4	
CHEM-1110	Chemistry I with Advanced Lab	4		ENGR-1100	Intro to Engineering Analysis ²	4	
MATH-1010	Calculus I	4		ENGR-1400 or 1200	Engineering Communications or Engineering Graphics/CAD	1	
PHYS-1100	Physics I ²	4		MATH-1020	Calculus II	4	
	Hum., Arts or Soc. Sci. Elective	4			Hum., Arts or Soc. Sci. Elective	4	
Fall 2017				Spring 2018			
CHME-2010	Material, Energy, and Entropy Balances	4		CHME-2020	Energy, Entropy, and Equilibrium ³	4	
CHEM-2250	Organic Chemistry I	3		CHEM-2260	Organic Chemistry II	3	
CSCI-1190	Beginning C Programming for Engineers	1		ENGR-2600	Modeling and Analysis of Uncertainty	3	
MATH-2400	Intro to Differential Equations	4			Hum., Arts or Soc. Sci. Elective	4	
PHYS-1200	Physics II	4			Free Elective	4	
Fall 2018				Spring 2019			
CHME-4010	Transport Phenomena I	4		CHME-4020	Transport Phenomena II	4	
CHME-4030	Chemical Process Dynamics and Control	4		CHEM-4420	Microscopic Physical Chemistry	3	
CHEM-4530	Modern Techniques in Chemistry	4			Hum., Arts or Soc. Sci. Elective	4	
	Hum., Arts or Soc. Sci. Elective	4			Free Elective	4	
					Professional Development II ⁴	2	
Fall 2019				Spring 2020			
CHME-4040	Chemical Engineering Separations	3		CHME-4050	Chemical Process Design	4	
CHME-4150	Chemical Engineering Lab I	3		CHME-4160 or 4170	Chemical Engineering Lab II or Bioprocessing Lab	3	

CHME-4500	Chemical Reactor Design	3		ENGR-4010	Professional Development III	1	
CHME	Chemical Engineering Elective	3		ENGR	Engineering Elective	4	
	Free Elective	4		CHEM	Chemistry Elective	3	
Electives	<p>The chemistry elective must be in advanced chemistry or advanced chemistry-related subject. This elective cannot be CHEM-4410 or CHEM-2440.</p> <p>The chemical engineering elective must be in chemical engineering or in an approved, advanced chemical engineering subject. The engineering elective cannot be a chemical engineering course; it must be at least 2000-level and contain 4 credits of engineering topics. This elective cannot be ENVE 2110 or ENGR 2250.</p> <p>The curriculum clearance officer, who maintains a list of appropriate courses, must approve selection of these three constrained electives. The three free electives are completely unconstrained.</p>			Footnotes	<p>¹ May be replaced by "ENGR-1300 Engineering Processes", although CHME-1010 is recommended.</p> <p>² May be taken in either order.</p> <p>³ Satisfies PD I requirement.</p> <p>⁴ Choice of STSS-4840 or PSYC-4170 or a course from the list of approved courses published each year.</p>		

Registration

When: Registration for the Spring semester generally occurs in early November. Registration for the Fall semester occurs the preceding Spring, usually in early April. Exact dates are included in the [Academic Calendar](#).

How: Use the [Student Information System \(SIS\)](#) to register for your courses.

Where: There are no assigned rooms for registration. You can register for your classes using any computer with Internet access.

Time tickets

School of Engineering

Freshman	0 - 30
Sophomore	31 - 60
Junior	61 - 95
Senior	96 - 128

As a student here at Rensselaer, you are issued a "time ticket," which assigns you a specific window of time during which you may register for the next semester. Your time ticket will be sent to your RPI email address, 2 - 3 weeks before registration.

Your registration time is assigned based on the number of credit hours you have **earned** as a student. The table to the right shows the range of earned credit hours associated with each class. Please note

that classes which are still in progress or courses which have been graded as "incomplete" do *not* count towards earned credits, nor do transferred courses and Advanced Placement (AP) credit.

You should receive your time ticket via e-mail approximately four weeks prior to the scheduled registration period. In addition to making the registration assignment, this e-mail message notifies you of any existing holds which may prevent you from registering if you do not resolve them.

CAPP reports

Your Curriculum Advising and Program Planning (CAPP) report is a planning and advising tool -- available only to undergraduate students -- that allows you to track the progress you're making toward your Bachelor's Degree. You can access your CAPP report via the main menu of the Student Information System (SIS).

Registration FAQs

What do I do if a class I want to register for is full?

Meet with the instructor of the course and request to be admitted to the course. If the class is a core/required course every effort will be made to accommodate the request. If this is an elective course you may be asked to take it in a subsequent semester. Note that for Core Engineering courses (ENGR prefix) there will be an electronic waitlist available at the time of registration which is capped at ten students per section.

How do I add/drop a course?

You may use the Student Information System (SIS) to add or drop courses. Generally speaking, from the beginning of the semester, you will have **two weeks to add** courses and **eight weeks to drop** them. Please refer to the Academic Calendar for specific add and drop deadline dates.

If you wish to petition to add or drop classes after the published deadline, you may do so using a Late Add/Drop Form. Please note that after the instructor's signature (if required), the form must also be approved by the Advising and Learning Assistance Center.

Professional / Student Societies in the Dept. of ChBE

Omega Chi Epsilon – Faculty Advisor: Pankaj Karande, CBIS 3217

RPI's chapter of Omega Chi Epsilon (OXE), the national chemical engineering honor society, has recognized excellent scholastic performance of junior, senior, and graduate chemical engineering students since 2004. The mission of our chapter extends beyond recognition of academic excellence; we also strive to benefit our department and our community. Our chapter is involved in a few community service activities: authoring an undergraduate handbook, hosting an annual graduate school symposium, and providing class registration advice. For more information, please visit our website at <http://omegachiepsilon.union.rpi.edu/> or email omegachiepsilon@union.rpi.edu.

Society of Biological Engineers – Faculty Advisor: Georges Belfort, CBIS 3209

SBE maintains student chapters to serve the intellectual and professional interests of students in the biological sciences. Through their individual and collective activities, the members of chapters are ambassadors for their chapter, for their biological engineering department, for their college/university, and for SBE. They are dedicated to the broader SBE mission to connect people, cultivate knowledge, and catalyze the future. Membership in SBE is now free to undergraduates. To join, fill out the [membership form](#).

American Institute of Chemical Engineering – Faculty Advisor: Pankaj Karande, CBIS 3217



The American Institute of Chemical Engineers (AIChE) is a national organization with the mission to "promote excellence in the development and practice of chemical engineering." Its membership ranges from undergraduate students to professors, professional engineers to executive officers in major corporations.

National Membership: This year, AIChE national membership is free, so we encourage everyone to join! It is a great way to network and take advantage of a large pool of resources, all for free. Sign up at <http://www.aiche.org/students>

RPI Membership: RPI has an additional AIChE Chapter Membership that costs **\$10**. Benefits to the RPI membership include:

- A chance to meet and connect with the faculty and other ChBE students
- Getting your resume out to the companies through our resume CD circulations
- Food and refreshments during our general body meetings
- RPI AIChE Events:
 - Plant Tours (from plastics to brewing beer)
 - Guest Speakers (from Chemical Engineering companies in the area)
 - General Body Meetings
 - Workshops
 - Bowling Nights/Movie Nights/Paintball/Laser Tag

If you would like to sign up for the RPI Chapter Membership, please visit our website at <http://www.rpi.edu/dept/chem-eng/WWW/AICHE/>

Undergraduate Research Program (URP)

URP information website: <http://undergrad.rpi.edu/update.do?catcenterkey=77>

URP application: <http://undergrad.rpi.edu/update.do?artcenterkey=117>

Rensselaer has a very strong Undergraduate Research Program. This is a program that allows students to work in a professor's laboratory for credit, cash, or experience. On average, we have 30% of the class taking advantage of these opportunities during their Rensselaer career. Many of our undergraduate students collaborate with graduate students and faculty on undergraduate research projects (URP). Plus, many of our students participate in Rensselaer's Undergraduate Research Forum & Awards... and often win!

Faculty research activities span a wide range of topics in biotechnology, nanotechnology and advanced materials. Much of this research is interdisciplinary, involving collaborative efforts with faculty in chemistry, mathematics, biology, as well as biomedical and materials engineering. The breadth of chemical engineering allows us to speak many technical "languages" and interact with scientists and engineers from a variety of disciplines.

The program offers many advantages and the opportunity to:

- Work on a project that's impact could be worldwide and can lead to patents and/or grants
- Apply knowledge gained in the classroom to actual problems and research situations
- Network with faculty beyond the classroom, opening the door to other opportunities
- Gain critical leadership, team-building and critical thinking skills
- Publish as an undergraduate
- Receive course credit in a more dynamic way or supplement your income

How to find a project

Most URP projects are found through direct contact with the faculty member supervising the research. Most undergraduates find projects from faculty members from whom they have taken classes. A good place to start your search is to determine a faculty member with whom you may want to work. Check their website to investigate their field of research. If it sounds interesting, approach them about a possible URP project. Please refer to page 18 for Faculty Research Interests.

What if I have my own idea for a project?

You may work with a faculty member on an existing research project or on a project based on your own ideas. If you want to pursue your own project, find a faculty advisor who may be interested in your topic since you will be required to have a project advisor.

For credit, funding or the experience?

You can earn from one to four credit hours per semester for your participation in the URP. The number of credit hours you earn is negotiable between you and your faculty sponsor. If you choose this option, you and your sponsor need to:

- Determine how many credit hours you will earn
- Decide exactly what is expected of you, such as your time commitment, the type of work to be submitted, etc.
- Agree on how your grade will be determined

The majority of participants earn \$400 per semester; however, in the past, students who have participated in the URP for pay have earned up to \$3,000 per semester.

URP funding comes from two sources:

- Your sponsoring faculty member or department
- The Office of Undergraduate Education

The faculty sponsor or department is responsible for the financial support of your research. In addition, the Office of Undergraduate Education pays URP participants a maximum of \$400 per semester in the form of matching funds.

Most projects expect eight to twelve hours of work per week.

Applying for the Experience

The URP application should be submitted to the Department Coordinator, Sharon Sorrell via email (sorels@rpi.edu). As your point of contact, she will:

- Set up an appointment to meet with you
- Check the URP Application for completeness
- Fill out your payroll paperwork
- Forward your application and payroll paperwork to the Office of Undergraduate Education for approval
- Will set up a schedule for reporting your hours. Please note: You must submit your hours to the Department Coordinator within the same payroll period that you worked. Keep in mind that if you work and submit hours that exceed your funding allotment, you will not be paid for those hours. Pay checks are issued every other Friday.

Is there a deadline?

Yes, the deadline to submit an application is the third Friday of the Fall semester and the third Friday of the Spring semester.

ChBE Faculty Research Interests

Chemical & Biological Engineering Current Research Interests 2015-16	Advanced Materials	Biochemical Engineering	Biomedical Engineering	Energy Sustainability	Fluid Mechanics	Interfacial Phenomena	Molecular Modeling & Simulations	Nanotechnology	Processes Control, Design & Optimization	Separation & Bioseparation Processes
Nihat Baysal	▪		▪	▪	▪		▪	▪	▪	
Georges Belfort	▪	▪	▪	▪	▪	▪		▪		▪
B. Wayne Bequette			▪	▪			▪		▪	
Vidhya Chakrapani	▪			▪		▪		▪		
Cynthia Collins		▪	▪	▪					▪	
Steven Cramer		▪	▪			▪	▪	▪		▪
Jonathan Dordick	▪	▪	▪	▪		▪		▪		
Shekhar Garde	▪	▪				▪	▪	▪		▪
Pankaj Karande		▪	▪					▪		▪
Mattheos Koffas		▪	▪	▪						▪
Sangwoo Lee	▪			▪		▪		▪		
Joel Plawsky	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪
Sufei Shi	▪			▪				▪		
Peter Tessier		▪	▪			▪		▪		▪
Patrick Underhill	▪			▪	▪		▪	▪		
JOINT APPOINTMENT										
Richard Gross		▪	▪							▪
Juergen Hahn		▪	▪						▪	▪
Amir Hirsra		▪			▪	▪				
Robert Linhardt	▪	▪	▪					▪		▪
ADJUNCT APPOINTMENT										

Marlene Belfort										
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Study Abroad – International Programs

The information on equivalent Chemical Engineering courses is found on the study abroad website. Otherwise, courses taken may sometimes be counted as a free elective, an engineering elective, a chemistry elective, or, in some cases, substitute for an H&SS requirement. Please meet with your undergraduate advisor EARLY (Freshman year / Sophomore year) to plan ahead if you are interested in studying abroad. You can visit the Office of International Programs at <http://admissions.rpi.edu/undergraduate/academics/reach.html> for more information.

Study Abroad FAQ's

Is study abroad a requirement? Study abroad is currently not a formal requirement, but all students are strongly encouraged to take part in an international experience.

When can a student study abroad? Students generally go abroad during their junior year, although this is not a rule. You will need to consider your academic progress (i.e. what courses you have already taken, what you will take while abroad, and what you will need to take upon return) in order to remain on track and graduate on time.

Can I go abroad as a senior? Yes, but keep in mind that the primary recruiting season for employers is fall of the senior year. Make sure to inform the Career Development Center of your plans if you choose to study abroad as a senior.

When should I start planning my study abroad experience? Applications are generally due one semester in advance of your planned term abroad. Early planning is key to ensuring that you remain on track academically.

Can I get credit for any study abroad or international experience? Academic credit is granted for participation in RPI-affiliated exchange programs that take place during the academic year, or for faculty-led summer programs.

What if I want to study abroad on a non-affiliated study abroad program? During the academic year, you must take a leave of absence and no credit will be granted. During the summer months and the holiday break, students are encouraged to participate in international experiences, but no academic credit will be granted (with the exception of some RPI faculty-led summer programs).

What types of RPI-affiliated programs are currently available? Exchanges, architecture semester programs, short-term faculty led summer programs. Again, please refer to the Office of International Programs website (listed above) for more information.

Does Rensselaer offer any international programs over the December-January semester break? No formal options are currently available, but the Office of International Programs is working to develop international opportunities for students to participate in during this period.

Am I guaranteed a space in the exchange program of my choice? No. Space is limited on most programs. You should visit the Office of International Programs on the 4th Floor of Academy Hall to reserve a space.

What is the application process for study abroad? Generally, students complete an RPI Study Abroad Application, the required application of the host institution, and submit an official transcript. Academic letters of recommendation and an essay are required for some programs.

Is a minimum GPA required? A 3.0 is generally required. Students who do not meet this requirement should discuss their plans with the appropriate study abroad administrator prior to completing an application.

What is the selection process for study abroad? All applications are reviewed by RPI faculty and study abroad staff. For most programs, an unofficial admissions decision is made at RPI, but official acceptances are always issued by the host institution.

Will my study abroad grades affect my Rensselaer GPA? No. Study abroad credits are effectively treated as transfer credits and are not factored into the GPA. The exceptions to this are the architecture programs which are taught by RPI faculty and treated as regular RPI courses.

What if I fail a course while on an exchange program? You must achieve the equivalent of a C- or better in order to receive RPI credit. If you fail a course, it will not show up on your transcript, but no credit will be granted.

Do courses taken abroad show up on the RPI transcript? No, only credits earned will appear on your official transcript. Your unofficial transcript will show the RPI course equivalent.

How many credits/classes do I need to take while abroad? In order to maintain full-time status, you must take the equivalent of 12 credits. The actual number of classes that you take will depend on the academic system of the host institution.

What classes may I take abroad? How do I find out what classes are available? This depends on the program. For most of the exchange programs, students select courses from among the regular course offerings at the host institution. For some programs, students select from a pre-approved list.

Do I need to have my course selections approved? YES! If you plan to participate in IMEP, GE³, or the Undergraduate Exchanges, you must complete a Transfer Credit Approval Form and obtain the signature of the appropriate Transfer Credit Approval Evaluator from each academic department, as well as that of your academic advisor.

How do I register for study abroad classes? In most cases, this is done directly with the host institution following their registration procedures for exchange students.

What is my student status during my study abroad term? Students who participate in RPI-affiliated study abroad programs remain registered at RPI with full-time student status.

How much does it cost to study abroad? Students pay regular RPI tuition for participation in an RPI-affiliated study abroad experience and receive full RPI credit. Transportation and living expenses are the responsibility of the student, and, in most cases, are paid directly by the student.

Can I receive financial aid for study abroad? Yes, students who participate in RPI-affiliated study abroad programs receive their full financial aid package (with the exception of work study money), including any RPI scholarships.

Is housing guaranteed? This depends on the site, but in most cases, no. Each host institution provides students with housing information, and it is the responsibility of the student to apply.

What is a visa? Do I need one? Who will get this for me? A visa, or entry permit, is a stamp or attachment in your passport that allows you to enter a specific country for a certain period of time. A visa is issued by the country that requires it. It is the responsibility of the student to make sure that he or she understands the visa requirements of the host country, to obtain the necessary application materials and supporting documents, and to apply according to the regulations of the host country. Common visa requirements include biometrics (fingerprinting) and an appointment at the Consulate of the host country (located in major U.S. cities).

What is REACH? Rensselaer Education Across Cultural Horizons, or REACH, is part of Rensselaer's initiative to provide all undergraduate students with an international experience. Initially launched in spring 2009 as an exchange program for engineering students, REACH has evolved to include all

international opportunities for undergraduates, including semester-long study abroad and exchange opportunities, short-term and faculty-led international programs, and other international experiences such as internships and service learning. All students are encouraged and expected to take advantage of some sort of international experience during their four-year undergraduate education.

What is the Global Engineering Education Exchange Program (Global E³)? Global E³ is an international exchange program for engineering students at member institutions. The program is designed to allow students to take courses overseas for credit at their home institutions. Currently, exchanges mainly occur with western European universities plus selected individual institutions in other world regions, including Asia, central and eastern Europe, and Latin America.

How can I learn more? Study abroad information sessions will be conducted at the beginning of the fall and spring semesters. You can also contact the appropriate program administrator for more information:

Karen Dvorak
Program Manager
Office of International Programs
4226 Academy Hall
518-276-3411

Jamie Obst
Senior Program Administrator
Office of International Programs
4227 Academy Hall
518-276-6663

Co-Terminal B.S. / M.S. or M.E. Program

The program is open only to current Rensselaer undergraduates. It is an honors program in chemical engineering intended to provide top students with the opportunity to apply for admission to the master's program at the end of the junior year and complete both the BS and ME degrees with one additional year of study. Co-terminal ME students are required to maintain a minimum GPA of 3.0 in advanced courses used towards their graduate degree. This program is not intended for students wishing to pursue a PhD degree, but does not exclude them should they wish to pursue it. However, the department recommends that those students apply directly to a PhD program at RPI or elsewhere.

The minimum eligibility requirements to be considered for admission into the program are listed below. Meeting these requirements does not guarantee admission and the final decision for admission rests with the graduate admissions committee in the department.

Eligibility requirements:

1. Two letters of recommendation: Reference forms are available at <http://www.rpi.edu/dept/admissions/resources/GraduateRecommendation.pdf>
2. Statement of purpose and goals (1-2 pages), indicating the applicant's reasons for pursuing the Co-Terminal program and preparations and qualifications for graduate work
3. A minimum average GPA of 3.5 in four core chemical engineering undergraduate courses: CHME 2010 (Material, Energy, and Entropy Balances); CHME 2020 (Energy, Entropy, and Equilibrium); CHME 4010 (Transport Phenomena I); and CHME 4030 (Chemical Process Dynamics and Control)

Co-terminal application website:

http://admissions.rpi.edu/graduate/admission/Co-TerminalBS-MS_Application_and_Procedures.pdf

Website with information from the Office of Graduate Education:

<http://gradoffice.rpi.edu/setup.do>

Co-Terminal FAQ's

Admission

1. **When do I apply?** Co-terminal applications must be submitted before the end of applicants' fall semester of the senior year. Applicants must have 90 credits (in progress or earned) of coursework towards their undergraduate degree (101 credits for Architecture students).
2. **Where do I find a Plan of Study?** The Plan of Study is available on-line at the Office of Graduate Education website [Plan of Study Form](#).
3. **What if the courses I list on the Plan of Study change?** If the courses listed change, an updated plan must be filed with your Department, the Office of Graduate Education, and the Office of the Registrar.

Financial Aid, Tuition, and Fees

1. **Can I receive both Undergraduate Financial Aid and Graduate TA/RA aid?** No, Master's students do not usually qualify for TA/RA support. If you receive a Graduate TA/RA, you are no longer eligible for undergraduate financial aid or the co-terminal program.
2. **Do I have to file a FAFSA for my 5th year to get the Undergraduate aid?** Yes, you must file a FAFSA, if you receive need based aid.
3. **I have a TA from my department. Do I need to notify anyone?** No, your department works with the Office of Graduate Education to ensure that your TA is processed appropriately. Once you accept a graduate TA, you are no longer eligible for undergraduate financial aid or the co-terminal program.

Academic

1. **When/how does a student get assigned a graduate adviser?** Co-terminal students will continue to work with their undergraduate adviser and should contact their department to be assigned a graduate advisor.
2. **How many credits will I be eligible to register for?** Since the primary degree you will be pursuing is your bachelor's degree, you will be eligible to register for up to 21 credits.
3. **Can I become a part-time student in the Co-Terminal Program?** Co-terminal students must remain as full-time students and cannot shift to part-time status.
4. **Should I apply for my undergraduate degree if I will be registered into an 11th semester?** If you are continuing into an 11th semester, you will no longer be eligible for undergraduate aid. You should apply for your bachelor's degree at that point.
5. **I was supposed to graduate in May 2019 but I will be completing 2 more semesters to receive my Master's degree under the co-terminal program. When do I receive my BS degree?** You will receive both degrees at the end of your 10th semester. You should file a degree application with the Office of the Registrar for each degree at the beginning of the semester in which you will actually graduate with both degrees. See the academic calendar for deadline information.
6. **Can I use a course for both my undergraduate and graduate degree?** No, credits applied toward satisfying requirements of the undergraduate degree cannot be used to satisfy the requirements for the master's degree.
7. **I finished my 9th semester but decided not to continue in the master's program. How do I receive my BS degree?** You must first formally withdraw from the co-terminal program. This is done using the [Graduate Student Request for Change of Status](#) form. You must then file a [Degree Application](#) for the next graduation date. Rensselaer has three official graduation dates - the end of August, the end of December, and mid-May. Check the academic calendar for application submission deadlines.
8. **Can I still designate courses as Pass/No Credit?** Co-terminal students are subject to graduate degree program guidelines after they've earned the minimum number of credits required for their bachelor's degree (which will range from 124 to 128 depending on the School). Any courses taken after a student has reached the minimum will be subject to graduate level policies, and graduate policies prohibit designating a graduate course as Pass/No Credit.
9. **Can I participate in the Commencement ceremony with my class?** You must meet the criteria for participation and file a petition, available in the Registrar's Office.

Graduate Program

Areas of Study/ Degrees	Chemical Engineering, MS, MEng, PhD	Typical Degree Requirements: MS 30 credits (24 coursework, 6 thesis) MEng 30 credits coursework PhD 72 credits beyond BS
Research Areas	We are actively pursuing research in a variety of multidisciplinary areas at the forefront of science and technology. Our research is externally funded by federal government and industry grants. Our research strengths are:	

	Advanced Materials Biochemical Engineering Biomedical Engineering Fluid Mechanics Drug Delivery Interfacial Phenomena	Mass Transport Molecular Simulations Polymers Process Control, Design, and Optimization Separation and Bioseparation Processes Thermodynamics
Research Centers	Center for Biotechnology and Interdisciplinary Studies Center for Future Energy Systems Center for Computational Innovations (CCI) Center for Automation Technologies and Systems (CATS) Fuel Cell and Hydrogen Research Center for Flow Physics and Control	Center for Materials, Devices, & Integrated Systems "Smart Lighting" Engineering Research Center Center for Cheminformatics Research New York State Center for Polymer Synthesis New York State Pollution Prevention Institute Center for Biological Functionally Organized Responsive Materials (BioFORM)
Admission	<p>Submit on-line at: http://gradadmissions.rpi.edu/</p> <p>Deadlines are January 1 for Summer and Fall admission and August 15 for Spring admission</p> <p>You'll need: a well-written Statement of Background & Goals; official transcripts from all colleges attended; at least 2 letters of recommendation (preferably from faculty); official GRE scores (minimum 550 GRE Verbal, general test only), Undergraduate GPA 3.0 or above, and official TOEFL or IELTS scores (570 required for all international applicants); non-refundable application fee.</p>	
Financial Aid/ Tuition	<p>Most students receive financial aid.</p> <p>Apply for financial aid through the admission application, <i>no separate form is required.</i></p> <p>Financial aid is available in the form of Fellowships, Teaching Assistantships, and Research Assistantships, that cover both tuition and stipend.</p> <p>International students are eligible for all forms of aid except some fellowships that require US citizenship.</p> <p>Awards are made based on merit with priority given to doctoral candidates.</p> <p>Tuition for the 2015-2016 academic year is \$48,100; Other expenses can vary widely, but we estimate them to be: fees and insurance are approximately \$2,339; Living expenses (\$13,320), books and supplies (\$2,841).</p>	
Contact Us	<p>Lee Vilar, Student Services Administrator, ChBE Student Services & Graduate Enrollment Ricketts 130, 110 8th Street, Troy, New York 12180-3590 Phone: (518) - 276-6929 Fax: (518) - 276-3089 Email: vilar@rpi.edu http://www.cbe.rpi.edu/</p>	

Application to the Doctoral Program in Chemical Engineering

Most successful Doctoral Program applicants have a Bachelor's degree in Chemical Engineering. The deadline for Fall applications is the preceding January 1st. The deadline for Spring applications is the previous August 15th. All required materials and scores must be received by the deadline for the application to be complete and sent to the Doctoral Review Committee. Please send all supporting required materials in one envelope to Graduate Admissions.

GRE and TOEFL scores (for International applicants) must be sent directly from the testing organization to Institute code 2757. We require a minimum of 570 on the TOEFL and 550 on the GRE Verbal. We only require the GRE general test. The GRE scores are valid for 5 years from the date of the exam. The TOEFL scores are valid for 2 years from the date of the exam. We require a minimum of 3.0 GPA on a 4 point scale on the undergraduate degree program. You may send us the unofficial test scores to begin your application process, but your application will not be considered complete until the official scores arrive from the testing institute.

We have a limited number of financial aid awards reserved for our most outstanding PhD applicants who have submitted a complete application by the deadline. Most financial awards are given for Fall admission. Normally, no aid is available for master's degree candidates. Most successful doctoral applicants have a Bachelor's degree in Chemical Engineering, evidence of interest in research, such as published papers in scholarly journals or conference proceedings or undergraduate independent research with a faculty mentor. You do not need to contact any professors at the time of application.

We encourage you to visit the Graduate Admissions Web site at: http://www.rpi.edu/dept/admissions/graduate/apply_now.html where you may apply directly on line.

Enrolling Students - Doctoral Program in Chemical Engineering

Upon your acceptance of our offer of admission, please be sure to update the ChBE Student Coordinator (Lee Vilardi, vilarl@rpi.edu) with an email address, mailing address, and phone number where you may be reached over the summer. Keep this information up-to-date to receive important news and information throughout your affiliation with the department.

Most doctoral students are fully supported for the 4 – 5 years of study. You must always be registered in full-time status to receive financial aid and stipend pay. You will be given more information about this process in your award letter. Elaine Belokopitsky (beloke@rpi.edu) is the Business Administrator who will administer your financial pay.

You will be notified of the **department graduate orientation** over the summer. The orientation is usually held the Wednesday prior to the first day of class.

New students are also required to attend an **Institute Orientation** program. All students who will be assigned as **first-time TAs** are **REQUIRED TO ATTEND THE MANDATORY TA TRAINING**. No exceptions may be made. Financial support is dependent upon completing the required training.

Doctoral students will be given many opportunities to explore which research area they would like to pursue. In mid-September, the new doctoral students will attend two evening sessions to hear presentations by the ChBE faculty. The faculty will briefly describe their current research interests. Students will then schedule individual appointments with at least six faculty members to further discuss topics of mutual interest. Students will be given a deadline to complete the appointments, and then will turn in their top three choices. The faculty will also give their top choices. The process takes approximately two additional weeks to finalize a student/research advisor match, and then each student is notified of the decision by letter.

You should meet regularly with your research advisor. You should also make a Graduate Plan of Study by November 1st of your first year, and then update the plan as necessary. The Graduate School and Registrar's office require a valid, signed, up-to-date plan be on file at all times.

In the spring of each term, doctoral students are required to meet with their advisor to complete the Doctoral Yearly Review. You will be sent an email indicating when this is due to the Office of Graduate Education.

Your research advisor will inform you of doctoral requirements and Institute requirements, such as nomination of your doctoral committee, completion of your Candidacy, and your Doctoral Defense.

Office of Graduate Education

<http://gradoffice.rpi.edu/setup.do>

1516 Peoples Avenue

(518) 276-2626

(518) 276-2256 fax

Registrar's Office

<http://srfs.rpi.edu/setup.do>

OPEN M-F 9am-4:30pm

2000 Level, Academy Hall

(518) 276-6231

(518) 276-6180 fax

Most forms you will need as a graduate student may be found at these Registrar and Grad Ed websites:

Grad Ed forms

<http://gradoffice.rpi.edu/update.do?catcenterkey=20>

Registrar forms

<http://registrar.rpi.edu/update.do?catcenterkey=29>

Frequently Asked Questions relating to the BS/Chemical Engineering degree:

- **Describe your curriculum.** The ChBE curriculum builds on the engineering core, requiring an additional ½ year of advanced chemistry, and courses in process control, separations, chemical-reactor design, transport phenomena, advanced thermodynamics, and ChBE laboratory and process design.
- **Minors?** Chemistry, Economics, Environmental Engineering, Biology and Management are popular options for minors.
- **Size of Graduating Class?** Currently, we have 407 undergraduate students: 97 seniors, 108 juniors, 99 sophomores and 103 freshmen.
- **Male/Female Ratio (2015/1016)?** 40% female students. The Institute average is typically 31%.
- **How Many Faculty?** Currently, 14 faculty, plus numerous affiliated RPI faculty. All have Ph.D.'s, and most have industrial and/or consulting experience.
- **Internship and Co-op Opportunities?** Ample. Over 25% of ChBE seniors have participated in a summer internship experience or co-op. More students opt for an internship so as to stay on schedule for graduation. Co-ops are possible with careful planning early in your studies.
- **Undergraduate Research?** There are numerous opportunities! About 15% of ChBE seniors have participated in Rensselaer's Undergraduate Research Program. Most faculty have openings for research experiences for credit, and some have funding.
- **Graduate Program?** We have a strong graduate program with about 65 full-time graduate students.
- **Eventual Employment Opportunities?** You name it: Chemicals, Petroleum, Personal Products, Biochemicals, Pharmaceuticals/Drug Delivery, Semiconductors, Aerospace, Utilities, Government/Military, Contractors/Consultants. The breadth of ChBE education provides our graduates with a diversity of career options.