

## Department of Chemical and Biomolecular Engineering



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Welcome to the Master of Chemical Engineering (MChE) program at Rice!

The MChE program offers a non-thesis degree intended to prepare students for a career in the field of chemical engineering. Opportunities for new graduates span industries focused on energy, (petro)chemical, materials, biotechnology, and environment and safety.

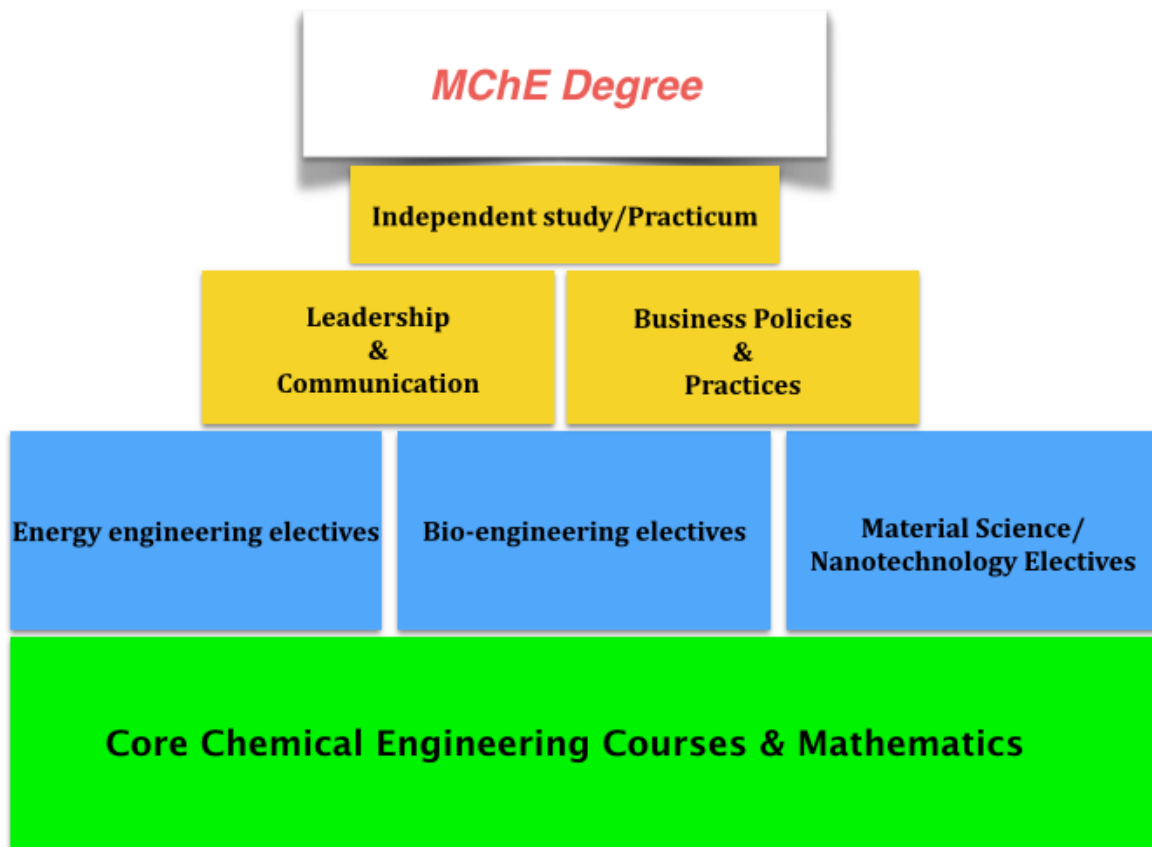
Students with a Bachelor's degree in Chemical Engineering can complete the course work in two semesters. The curriculum also allows for students with a non-chemical engineering background to obtain the MChE degree. For such students, additional semesters are needed in order to take foundational chemical engineering courses that would be expected of a student with a bachelor's degree in chemical engineering. Besides courses within the department, ample opportunities exist for students to take courses in other departments to fulfill degree requirements.

Our program places a strong emphasis on the overall professional development of the student. Students have opportunities to enhance their communication skills, understand engineering leadership and project management, and interact with industry representatives through seminars and career-development workshops.

We continuously seek to revise and adapt the curriculum to maintain high academic standards and better meet current and expected future industry needs. Sample courses/plan given below should thus be treated only as a broad guideline to get you started in fashioning your studies at Rice.

Our heartiest best wishes as you embark on a new adventure!

## Program Overview



1. Minimum of 30 credit hrs of courses at 500 level or higher
  - Minimum of 18 hrs (6× 3-credit hours) of CHBE courses which include five (5) core courses noted below and one (1) CHBE elective
  - Remaining electives can be from approved engineering, natural science, policy, and management courses
  - A minimum of 24 credit hours must be completed at Rice
  - Students with a non-Chemical Engineering Undergraduate degree are required to take core undergraduate chemical engineering courses, but these will not count towards the MChE degree
2. Students are required to take the following core graduate chemical engineering courses
  - a) Thermodynamics (CHBE 611)
  - b) Transport (CHBE 501 and CHBE 602)
  - c) Kinetics (CHBE 590)
  - d) Applied Numerical Methods (CHBE 505)
3. Students must maintain a grade of B- or better in each course
4. Students must meet the residency requirement

## Program Policies and Procedures

### 1 Advising Meetings

Before registering for courses, students are required to meet with MChE Director and confirm their plans. Students should come prepared with a concise and clean write-up of their plans for the coming semester and notes/observations about their (evolving) career plans. The Program Director will maintain an electronic record of the advising meeting. The student must inform the Program Director of any course selection updates made after the advising meeting. Unapproved course changes may not be certified by the Program Director.

### 2 Independent study (CHBE 695) and Internships

CHBE 695, offered both in fall and in spring, can be used to undertake independent study either in a research group in the department or outside in an industrial setting. Final decision on accepting the proposal for independent study and the number of credit hours to be assigned rests with the Director of the MChE program, who is also the instructor for CHBE 695, and the chair of the graduate studies committee. A student may end up taking more than three (3) credits of CHBE 695 over their course of study at Rice, but only a maximum of 3 credits (or the actual credits if less than 3) will be counted towards the degree.

For off-campus independent study, the student needs to first present an offer letter from the company stating clearly the work the student will pursue. The student needs to make an initial written presentation on how the work will contribute to his/her professional and intellectual development in Chemical and Biomolecular engineering. After approval by the Director of the MChE program, the student is required to turn in biweekly reports (duly signed by the off-campus supervisor) documenting their progress. For such off-campus independent study, the student may accept appropriate financial compensation from the company offering the internship. Foreign students additionally need to have a curricular practical training (CPT) endorsement for off-campus work.

#### 2.1 Summer Internships under ENGI 530

- Locate an appropriate internship and secure an offer letter
- Discuss the position with the MChE Director to ensure this is appropriate practical training and agree upon appropriate work samples that you will provide for us to evaluate your work. You will also need an industrial mentor to monitor and evaluate your progress
- After these steps, the MChE Director will confirm the plans with Dr. Renata Ramos, Associate Dean of Academic Affairs, who leads ENGI 530. You should then print and sign the ENGI 530 student agreement form and deliver it to Dean Ramos (please contact Ms. Pamela Traylor — pt3@rice.edu — for an appointment).
- International students should also complete the form to request CPT authorization (available from OISS) and take it to Dean Ramos for signature, since it is under ENGI 530 that you will do the internship.

### 3 Seminar Series

The seminar series is a vital part of the overall graduate learning experience. The department hosts a seminar speaker each week during the fall and spring semesters. Per the PhD Policies and Procedures, all doctoral students are required to register for the graduate seminar course, CHBE 661 (Fall) and CHBE 662 (Spring) each semester in residence. MChE students may also register for the seminar course and earn the appropriate course credit. All students registering for the class must be in attendance to receive the credit hour(s). Prior approval must be requested to the Graduate Studies Committee and the MChE Program Director to obtain an excused absence. More than two (2) unexcused absences will result in an unsatisfactory seminar grade for the semester. Students should subscribe to the department seminar mailing list ([ow.ly/oOSsb](http://ow.ly/oOSsb)) to make sure they receive the weekly seminar announcements and notify the Academic Program Administrator of their enrollment in the seminar course.

### 4 Satisfactory Progress

MChE students are expected to make continuous and satisfactory progress towards fulfilling the degree requirements. Students must maintain a grade of B- or better in each course. In accordance with university policy (see General Announcements at [ga.rice.edu](http://ga.rice.edu)) students whose CGPA falls below 2.67 or the semester GPA falls below 2.33 are placed on probationary status. University policy further states that any student placed on probationary status for a second semester will lead to an automatic dismissal by the Office of Graduate and Postdoctoral Studies, unless the student's department presents a plea for exception that is approved by the Dean of Graduate and Postdoctoral Studies.

### 5 Degree Certification

The MChE Program Director will certify Masters student degrees as complete in Degree Works, a web-based, degree-auditing and tracking tool that will enable a student to evaluate academic progress toward graduation. Within Degree works, the student should be able to identify quickly which degree requirements have been completed and which requirements are outstanding. Final certification must be completed in a timely manner once a student files an application for degree conferral with the Office of the Registrar.

Students may access Degree Works at [registrar.rice.edu/students/dw\\_instructions/](http://registrar.rice.edu/students/dw_instructions/) .

### 6 Degree Conferral

Students can graduate at the end of the Fall, Spring, or Summer semesters. In order to qualify for a given commencement, students must meet the submission deadline for commencement per the appropriate Academic Calendar. Please confirm your plans well in advance of the deadline with the MChE Director.

## 7 Transfer to the MS Program/PhD program

The MChE degree is a terminal degree. Ideally, after graduation, students should plan to pursue their career either in industry, or, for greater and more diverse intellectual enrichment, in a different academic institution. Students who wish to pursue a PhD in Chemical and Biomolecular Engineering at Rice must apply afresh to be considered for the doctoral program. Note that only in exceptional cases will such students be admitted to the Chemical and Biomolecular doctoral program.

MChE students who have undertaken independent study with a faculty in the department, can with input from their faculty mentor, apply to switch to the thesis-based MS program. Based on inputs from the faculty mentor and the Director of the MChE program, the graduate committee may allow the student to switch to the MS program.

## 8 Rice University Policies Applicable To All Graduate Students

### 8.1 Leaves Of Absence

All graduate students are expected to maintain continuous enrollment, unless an official leave of absence has been granted. Failure to register for any period without a leave of absence granted by the Associate Provost constitutes *de facto* withdrawal. If a student later wishes to resume study, reapplication is required. Readmission is given only on the recommendation of the department and the approval of the Associate Provost.

A leave of absence is granted by the Office of Graduate and Postdoctoral Studies upon the recommendation of the department and that too only to a student in good standing with the university. Leave must be approved in advance of the academic semester in question; it will not be granted after the student has registered for courses or after the registration period has passed. Normally, a leave of absence is granted for no more than two consecutive semesters. No work toward a degree may be done at Rice or involve Rice faculty (or facilities) during a student's leave of absence.

### 8.2 Residency Requirement And Part-time Status

Semester course load for full-time students is nine (9) hours. Minimum residency for schools of engineering is one Fall or Spring semester in full time or part time graduate study. Students dropping below the nine hours and registering for at least three hours are considered part-time. Students who wish to obtain part-time status must notify and obtain written permission from the MChE Director and the Academic Coordinator before the semester begins. A part-time status request will then be sent to the Office of Graduate and Postdoctoral Studies for final approval.

International students must obtain approval from the Office of International Students and Scholars (OISS) before dropping below the minimum hours required for full-time students; the request for approval is made by presenting a completed Reduced Course Load Authorization Form found on the OISS webpage. International students must verify with the department that this process has been completed with OISS before the formal request can be made to the Office of Graduate and Postdoctoral Studies. To maintain legal immigration status, international students are allowed to go part-time only in their final semester of study.

As a part-time student the tuition paid will be based on the number of registered hours times the hourly tuition rate. Rates are found in the General Announcements/Tuition, Fees & Expenses at

ga.rice.edu. Students are assessed a one-time per semester part-time enrollment fee of \$150 when enrolled for less than 9 credits.

## **9 Guidelines For Dismissals, Petitions, Appeals, Grievances, And Problem Resolution**

Rice University graduate students have guidelines to assure fairness in problem resolution. These policies strive to uphold standards and raise the quality of graduate programs. They provide graduate students with an environment that has high standards, clear assessments of the student's achievements and fair and transparent procedures for handling cases of inadequate academic progress. Please find the complete list of guidelines in the General Announcements for graduate students at ga.rice.edu. These guidelines are to be followed by all Rice graduate students. The CHBE Graduate Studies Committee will be the standing committee for all issues regarding these guidelines.

## **10 Title IX Sexual Misconduct Policy**

Rice encourages any student who has experienced an incident of sexual, relationship, or other interpersonal violence, harassment or gender discrimination to seek support. There are many options available both on and off campus for all graduate students, regardless of whether the perpetrator was a fellow student, a staff or faculty member, or someone not affiliated with the university.

Students should be aware when seeking support on campus that most employees are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. The therapists at the Rice Counseling Center and the doctors at Student Health Services are confidential, meaning that Rice will not be informed about the incident if a student discloses to one of these Rice staff members. Rice prioritizes student privacy and safety, and only share disclosed information on a need-to-know basis. If you are in need of assistance or simply would like to talk to someone, please call Rice Wellbeing and Counseling Center, which includes Title IX Support: (713)348-3311.

Policies, including Sexual Misconduct Policy and Student Code of Conduct, and more information regarding Title IX can be found at safe.rice.edu.

## **11 Honor System**

Students take all written examinations and complete any specifically designated assignments under the honor system. By committing themselves to the honor system, all students accept responsibility for assuring the integrity of the examinations and assignments conducted under it. The Graduate Honor Council (GHC) is responsible for investigating reported violations and for conducting a hearing when the facts warrant. The Office of Student Judicial Programs, which reviews the results of the investigations and hearings, considers the GHC's recommendations when issuing penalties. Procedures for accusations arising out of summer classes or Rice Online classes may differ.

## Course Options and Suggested Plans

### 12 CHBE Course Options

Our course offerings are periodically updated. The list below are typical course offerings within the department. Courses marked with an asterisk are required.

1. CHBE 501 (Fall) Fluid Mechanics and Transport Processes\*
2. CHBE 505 (Fall) Advanced Numerical Methods\*
3. CHBE 590 (Fall) Advanced Reaction Engineering\*
4. CHBE 602 (Spring) Physicochemical Hydrodynamics\*
5. CHBE 611 (Spring) Advanced Thermodynamics\*
6. CHBE 503 (Fall) Design Fundamentals
7. CHBE 506 (Fall/Spring) Decision Tools for Chemical Engineers
8. CHBE 515 (Spring) Separation Processes
9. CHBE 516 (Spring) Structure and Properties of Polymers and Soft Materials
10. CHBE 518 (Fall) Material Physics and Solid State Devices
11. CHBE 519 (Spring) Atomistic Simulation Methods and Engineering Applications
12. CHBE 523 (Fall) Bioengineering Systems and Control
13. CHBE 552 (Fall) Energy Resources
14. CHBE 558 (Fall) Genome Editing and Engineering
15. CHBE 560 (Spring) Colloidal and Interfacial Phenomena (offered even years)
16. CHBE 594 (Spring) Properties of Polymers (offered odd years)
17. CHBE 603 (Fall) Rheology (not offered every year)
18. CHBE 615 (Fall) Application of Molecular Simulation and Statistical Mechanics
19. CHBE 634 (Fall) Surface Analysis Methods
20. CHBE 571 (Spring) Flow and Transport Through Porous Media I (offered odd years)
21. CHBE 671 (Spring) Flow and Transport Through Porous Media II (offered even years)
22. CHBE 692 (Fall) Applied Mathematics for Chemical Engineering
23. CHBE 695 (Fall/Spring) Independent Study

For students entering with a non-Chemical Engineering background the following courses are required (unless specific waivers are granted on a case-by-case basis)

1. CHBE 390 (Fall) Kinetics & Reactor Design
2. CHBE 401/402 (Fall/Spring) Transport Phenomena I and II
3. CHBE 411/412 (Fall/Spring) Thermodynamics I and II
4. CHBE 503 (Fall) Design Fundamentals — will count towards MChE requirements

## 13 Possible Electives

The list below is simply to give you a flavor for what is available within Rice.

### 13.1 BIOE (Bioengineering)

1. BIOE 535 (Fall) Engineering Cell-based Therapeutics for the Treatment of Diseases
2. BIOE 518 (Spring) Introduction to Computational Biology
3. BIOE 554 (Fall) Computational Fluid Mechanics
4. BIOE 548 (Fall) Neural Signal Processing
5. BIOE 589 (Fall) Computational Molecular Bioengineering/Biophysics

### 13.2 CAAM (Computational and Applied Mathematics)

1. CAAM 519 (Fall) Computational Science I
2. CAAM 520 (Spring) Computational Science II
3. CAAM 552 (Fall) Finite Element Methods
4. CAAM 536 (Spring) Numerical Methods for PDEs
5. CAAM 564 (Spring) Numerical Optimization
6. CAAM 583 (Fall) Introduction to Random Processes and Applications

### 13.3 CHEM (CHEMISTRY)

1. CHEM 530/531 (Fall/Spring) Quantum Chemistry/Advanced Quantum Chemistry
2. CHEM 533 (Spring) Nanoscience and Nanotechnology
3. CHEM 554 (Fall) Drug Discovery



**13.4 CEVE (Civil & Environmental Engineering)**

1. CEVE 502 (Fall) Sustainable Design
2. CEVE 507 (Spring) Energy and The Environment
3. CEVE 510 (Fall) Principles of Environmental Engineering
4. CEVE 534 (Fall) Fate and Transport of Contaminants in the Environment
5. CEVE 535 (Spring) Physical and Chemical Processes For Water Quality Control
6. CEVE 536 (Spring) Environmental Biotechnology
7. CEVE 592 (Fall) Modeling and Analysis of Networked Systems
8. CEVE 520 (Spring) Environmental Remediation and Restoration

**13.5 ECON (Economics)**

1. ECON 504 (Fall) Computational Economics
2. ECON 601 (Fall) Energy Economics I

Please talk to the instructor before registering for ECON courses.

**13.6 ESCI (EARTH SCIENCE)**

1. ESCI 544 (Spring) Hydrocarbon Exploration
2. ESCI 549 (Fall) Data Management and Data Governance
3. ESCI 570 (Fall) Computational and Data Science in the Energy Industry
4. ESCI 672 (Fall) Earth systems modeling
5. ESCI 699 (Fall) Visual Design For Scientists

**13.7 ELEC (ELECTRICAL & COMPUTER ENGINEERING)**

1. ELEC 535 (Fall) Information Theory
2. ELEC 578 (Fall) Introduction to Machine Learning
3. ELEC 585 (Fall) Fundamentals of Medical Imaging I
4. ELEC 587 (Fall) Introduction to Neuroengineering
5. ELEC 680 (Spring) Nano-neurotechnology

**13.8 ENGI (ENGINEERING)**

1. ENGI 510 (Spring) Technical and Managerial Communication
2. ENGI 515 (Fall/Spring) Leading Teams and Innovation
3. ENGI 530 (Fall/Spring) Engineering Practicum
4. ENGI 542 (Spring) Communication for Engineers
5. ENGI 545 (Spring) Strategic Thinking
6. ENGI 601 (Fall) Engineering Communications Workshop
7. ENGI 610 (Fall) Management for Science and Engineering
8. ENGI 614 (Fall; 2 credit) Learning how to innovate?
9. ENGI 615 (Fall/Spring) Leadership coaching for engineers

**13.9 MGMT (Jones School)**

There are good choices in the Jones School; for example, see below:

1. MGMT 625 (Spring) Design Thinking

Please talk to the instructor before registering.

**13.10 MSNE (Material Science and Nanoengineering)**

1. MSNE 502 (Fall) Mechanical Properties of Materials
2. MSNE 505 (Spring) Microstructure and Nanostructure Evolution
3. MSNE 510 (Spring) Scaling concepts in 2D materials and Polymer physics
4. MSNE 523 (Fall) Design of composite materials
5. MSNE 533 (Spring) Computational Materials Modeling
6. MSNE 569 (Spring) Corrosion science and engineering

**13.11 PHYS (Physics)**

1. PHYS 521 (Fall) Quantum Mechanics I
2. PHYS 533/534 (Fall/Spring) Nanostructure and nanotechnology I/II
3. PHYS 551 (Fall/Spring) Biological Physics

**13.12 STAT (Statistics)**

1. STAT 515 (Spring) Data Science Consulting
2. STAT 525 (Fall) Bayesian Statistics
3. STAT 604 (Fall) Computational Economics
4. STAT 605 (Fall/Spring) R for Data Science (computing heavy)
5. STAT 682 (Fall) Quantitative Financial Analytics

## 14 Sample Plans

### 14.1 Two (2) Semester Plan Emphasizing Chemical Engineering Fundamentals

Fall 1 <sup>st</sup> Semester	Spring 2 <sup>nd</sup> Semester
CHBE 501	CHBE 602
CHBE 590	CHBE 611
CHBE 505	CHBE Elective
Elective	Elective
Elective	Elective

### 14.2 Three (3) Semester Plan Emphasizing Chemical Engineering Fundamentals

Fall 1 <sup>st</sup> Semester	Spring 2 <sup>nd</sup> Semester	Summer	Fall 3 <sup>rd</sup> Semester
CHBE 501	CHBE 602		Elective
CHBE 590	CHBE 611	ENGI 530 <sup>‡</sup>	Elective
CHBE 505	CHBE Elective		(Elective)
(Elective)	(Elective)		

<sup>‡</sup>Engineering Practicum; Students can move the electives around to even out the load

### 14.3 Three (3) Semester Plan With Focus on Energy Engineering or Material Science and Nanoengineering or Biotechnology/Bioengineering

Fall 1 <sup>st</sup> Semester	Spring 2 <sup>nd</sup> Semester	Summer	Fall 3 <sup>rd</sup> Semester
CHBE 501	CHBE 602		CHBE Elective
CHBE 590	CHBE 611	ENGI 530	(CHBE 695)
CHBE 505	(CHBE 695)		(Elective)
(Elective)	(Elective)		(Elective)

The outline above is meant as a guide to fashion a program of study with an emphasis on a sub-discipline. Depending on the concentration of interest and the background of the student, it may be possible to move around CHBE 590 or 505 or the CHBE electives to better focus on electives in the sub-discipline of interest. It is highly recommended that the student pursue Independent Study (CHBE 695) to advance their knowledge in the sub-discipline of interest.