UC DAVISC
CHEMICAL ENGINEERING

# GRADUATE STUDENT HANDBOOK

*2019*

# Contents

# Degrees in Chemical Engineering

## Master of Engineering

The one-year Master of Engineering (M.Eng.) degree is the most flexible degree we offer. With a wide variety of elective courses to choose from, you can mold the degree to fit your interests and goals, whether they include training in additional engineering, computer science or management courses.

Students with a background in any science or engineering-related field are encouraged to apply. Minimum qualifications for the degree involve a full year of physics, chemistry and engineering-level math, including linear algebra and differential equations. No prior research experience is required, though demonstration of success in some undergraduate core coursework in chemical engineering will strengthen your application.

The M.Eng. degree can be completed at full-time or part-time status and is open to both recent graduates and those currently in the workforce. The majority of our master's students find jobs in industry after graduation.

### Course Requirements

You will begin with the core courses for the degree and our "Preparing for Graduate Student Success" course (ECH 200), which will match you with a major professor over the course of your first fall quarter. Students will select any combination of 12 units from the following core courses:

ECH 252: Statistical Thermodynamics

ECH 253A: Advanced Fluid Mechanics

ECH 253C: Advanced Mass Transfer

ECH 256: Chemical Kinetics and Reaction Engineering.

ECH 259: Advanced Engineering Mathematics

For electives, student should take two units of ECH 290. For the remaining elective units, students may select from any available upper-division undergraduate course (courses numbered 100-199) or graduate-level course (courses numbered 200-299). Popular electives include those from physics, chemistry, computer science, management and other engineering disciplines. In consultation with your major professor, you will select courses each quarter based on your career goals and aspirations. Students should plan to take at least three units of ECH 299 units, but no more than 9 units of ECH 299.

### Sample Schedule (Full-time student)

| Fall | Winter | Spring |
|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| ECH 252 | 4 | ECH 290: Seminar | 1 | ECH 290: Seminar | 1 |
| ECH 253A | 4 | Elective (1XX/2XX) | 4 | ECH 299: Research | 11 |
| ECH 256 | 4 | Elective (2XX) | 4 | *Capstone Project* | |
| ECH 200 | 1 | Elective (2XX) | 4 | | |
| | | *Advance to Candidacy* | | *Graduate* | |

### Capstone Project

The capstone project is a report, usually completed in the last quarter of study. The report should address a current topic in the general area of chemical engineering and offer a comprehensive review of the literature, clearly articulating open research directions and challenges that still remain to be tackled. The report can be viewed as a preliminary literature survey for a potential NSF proposal submission and should demonstrate the student's understanding of the fundamental concepts and the student's critical thinking ability. This report is then graded by three faculty members, on a pass, no pass, or fail basis. Since the M.Eng. is a coursework-based degree, there is no need to write a thesis.

Further information on the capstone project may be found in the full degree requirements.

## Master of Science

The Master of Science (M.S.) degree is aimed at preparing students for careers in research and development, or for further study in the field. Like the doctoral degree, the M.S. degree combines coursework and research, but with a more limited scope of the research project and thesis to reflect the shorter time-to-degree. After graduation, the majority of our master's students find jobs in industry.

### Course Requirements

You will begin with the core courses for the degree and our "Preparing for Graduate Student Success" course (ECH 200), which will match you with a major professor over the course of your first fall quarter. The five core courses are listed below:

ECH 252: Statistical Thermodynamics

ECH 253A: Advanced Fluid Mechanics

ECH 253C: Advanced Mass Transfer

ECH 256: Chemical Kinetics and Reaction Engineering.

ECH 259: Advanced Engineering Mathematics

For electives, you can select from any available upper-division undergraduate course (courses numbered 100-199) or graduate-level course (courses numbered 200-299). Popular electives include those from physics, chemistry, computer science, management

and other engineering disciplines. In consultation with your major professor, you will select courses each quarter based on your career goals and aspirations.

Students are also expected to complete two quarters of ECH 290: "Department Seminar," which requires students to attend a majority of the weekly departmental lectures by visiting scholars in the field. This course exposes graduate students to the latest advances in materials science and engineering.

### Sample Schedule (Full-time student)

| *Year 1 - Fall* | | *Winter* | | *Spring* | |
|---|---|---|---|---|---|
| ECH 252 | 4 | ECH 253C | 4 | Elective (1XX/2XX) | 4 |
| ECH 253A | 4 | ECH 259 | 4 | Elective (1XX/2XX) | 3 |
| ECH 256 | 4 | Elective (1XX/2XX) | 3 | ECH 299: Research | 5 |
| ECH 200 | 1 | ECH 290 | 1 | | |
| | | | | | |

| *Year 2 - Fall* | | *Winter* | | *Spring* | |
|---|---|---|---|---|---|
| ECH 299 | 11 | ECH 299 | 12 | ECH 299 | 12 |
| ECH 290 | 1 | *Advance to Candidacy* | | *File Thesis* | |
| | | | | *Graduate* | |

### Thesis

The master's thesis should represent a student's original contribution to the knowledge in the field, and the research should be conducted under the supervision of a faculty member. Students advancing to candidacy should prepare an outline of their thesis, which should include a critical evaluation of the methods and limitations of the research project and a full description of the experimental design, protocols and data analysis. There are no limitations on the length or the number of publications required.

Read the full list of degree requirements for more information.

## Doctoral Degree (Ph.D.)

The doctoral (Ph.D.) degree prepares students to solve complex, long-term research problems. You can expect to graduate in four to five years and to work on a large research project, culminating in a dissertation. The majority of our doctoral graduates end up in industry careers, usually in research and product development positions. Others go on to careers in academia, either as a postdoctoral researcher or an assistant professor.

### Course Requirements

Doctoral students complete the same core courses as the master's degree students, but have additional examinations along the way that test both the breadth and depth of their chemical engineering knowledge. Over the course of your first fall quarter, you will be matched with a major professor through the "Preparing for Graduate Student Success" course (ECH 200). The five core classes mentioned above are listed below:

ECH 252: Statistical Thermodynamics

ECH 253A: Advanced Fluid Mechanics

ECH 253C: Advanced Mass Transfer

ECH 256: Chemical Kinetics and Reaction Engineering.

ECH 259: Advanced Engineering Mathematics

For electives, you can select from any available upper-division undergraduate course (courses numbered 100-199) or graduate level course (courses numbered 200-299) in a science or engineering discipline. Doctoral students are encouraged to select any physics, chemistry, mathematics or engineering-related courses that will assist them in preparing for their dissertation research.

You are also expected to enroll in ECH 290: "Department Seminar" four times as students prepare for their qualifying examinations. The course requires students to attend a majority of the weekly departmental lectures by visiting scholars in the field, exposing them to the latest advances in materials science and engineering.

### Sample Schedule (Full-time student, Years 1 and 2)

| *Year 1 - Fall* | | *Winter* | | *Spring* | |
|---|---|---|---|---|---|
| ECH 252 | 4 | ECH 253C | 4 | Elective (2XX) | 3 |
| ECH 253A | 4 | ECH 259 | 4 | ECH 299: Research | 8 |
| ECH 256 | 4 | Elective (1XX/2XX) | 3 | ECH 290 | 1 |
| ECH 200 | 1 | ECH 290 | 1 | | |
| ECH 290 | 1 | | | *Preliminary Exam* | |

| *Year 2 - Fall* | | *Winter* | | *Spring* | |
|---|---|---|---|---|---|
| Elective (2XX) | 3 | Elective (2XX) | 3-4 | ECH 299 | 12 |
| Elective (2XX) | 3 | ECH 299 | 8-9 | | |
| ECH 299 | 3-4 | | | *Qualifying Exam* | |
| ECH 290 | 1 | | | *Advance to Candidacy* | |

In years three and four, students will enroll in 12 units of research each quarter and begin working on dissertation research and writing until graduation at the end of year four or five.

### Transferring Coursework

Graduate-level coursework completed at another institution may be substituted for elective or required coursework in some cases, depending on the content of the course. If a graduate-level course was taken during the student's undergraduate degree program, you must prove that the course was not used to satisfy the bachelor's degree requirements. Transferred courses are evaluated through an internal process by the

instructor of the course at UC Davis. If approved, the course is waived for the student. The waived course does not formally appear on the UC Davis transcript as a transferred course, but does appear on the internal Program of Study form (Appendix A) as satisfying the course requirements for the degree.

### Preliminary Exam

Taken in spring quarter of your first year, this exam consists of a 10-minute presentation followed by 20 minutes of questioning by a committee consisting of five faculty members, including your major professor. Prior to the exam, students prepare a one-page abstract containing a general overview and critical assessment of two to three research articles. The exam assesses your ability to communicate a solid understanding of fundamental scientific and engineering concepts, particularly in the context of your research topic. You must complete all core courses and maintain at least a 3.25 GPA to be eligible to take the exam.

### Qualifying Exam

Like the preliminary exam, the qualifying exam contains both a written and an oral portion. The written portion consists of a 10-15 page dissertation research proposal and bibliography that follows a format similar to an NSF or NIH grant proposal. After distributing the proposal to the committee, the student prepares a 30-35 minute oral presentation, during which a faculty committee will question the student. The qualifying exam committee consists of four graduate program faculty members and one external faculty member. Major professors are not allowed to participate on the qualifying exam committee.

### Exit Seminar

After you complete your dissertation, you will present your research to the department prior to scheduling an appointment with Graduate Studies to submit your dissertation. At least two of your dissertation committee members must be present at the exit seminar. If the seminar is successfully completed, the committee will sign off on the dissertation signature page. Note that original signatures are required. Scanned images or electronic signatures will not be accepted.

### Designated Emphases (DE)

As a doctoral student, you have the unique opportunity to participate in an affiliated designated emphasis (DE). A DE is similar in concept to an undergraduate minor. You will be required to complete additional coursework and must have a faculty member from that DE serve on both the qualifying exam committee and the dissertation committee. Students who successfully complete the DE will have a notation included on their diploma and transcript. The Chemical Engineering graduate program is affiliated with three designated emphases:

- Biophotonics and Bioimaging: https://biophotonics.bme.ucdavis.edu/
- Biotechnology: http://deb.ucdavis.edu/
- Nuclear Science: http://dens.physics.ucdavis.edu/

# Milestones

## Beginning Graduate School

Most new students arrive in Davis in early-to-mid-September, as housing leases generally begin on September 1st. You'll want to start looking for housing right away, as vacancies can fill up quickly (we've included a link for housing resources at the bottom of this page). Additionally, Graduate Studies at UC Davis has created a Facebook group for admitted students, so you can connect with other new graduate students. This group will also be an important resource for the most up-to-date announcements regarding Graduate Studies orientation.

### Steps to Attend UC Davis

1. Submit your Statement of Intent to Register (SIR) at the bottom of your Graduate Studies admission email.
2. Doctoral students: return your signed funding offer letter.
3. Create a UC Davis computing account.
4. Send in your official transcripts
5. Submit your Statement of Legal Residency.

Once these five steps have been completed and verified by a staff advisor, you will receive information regarding registration for classes. You should also begin registering for mandatory orientations and trainings.

## The First Year

### Finding a Major Professor

You can expect at least one main milestone in your first year—finding a major professor. During fall quarter, students participate in "Preparing for Graduate Student Success" (ECH 200), which matches you with a major professor. In general, you should plan to meet with at least five to six faculty members by the midway point of the quarter. Attending group meetings is also a great way to meet a faculty member's students and learn about current research projects. From there, you should narrow your preferences down to the top three research groups you would like to join. Preferences are then collected from the faculty, and the department chair, the graduate program chair and staff advisors meet to match students and faculty. This process is usually complete by the end of fall quarter.

The expectation is that doctoral students will choose a funded project with a graduate program faculty member. If a doctoral student elects to pursue a doctoral degree with an unfunded project then the Graduate Program Chair will inform the student in writing of the consequences such a decision will have on the financial offer made to the doctoral student at admission. If a student chooses a faculty outside of the graduate program, the student must find a faculty member within the graduate program to serve as a co-chair.

#### *Changing Your Major Professor*

Under certain circumstances, the graduate program recognizes that there may be valid reasons for a graduate student to want to change the major professor. If a student should

choose to request a change in major professor, the graduate program will make every effort to be helpful and to ensure that this is not a barrier to completion of the degree. However, it is important to note that a change in a major professor may result in loss of extramural support for the doctoral student since the graduate program cannot always assure the doctoral student that a funded project will be available when the change in major professor is made. Furthermore, such a change may increase the time to degree.

If a student wants to change their major professor, they should take the below steps:
1. Graduate student should inform the Graduate Program Chair in writing and give reasons for the requested change.

2. The Program Chair must meet with the student within one week of receipt of the written notice to discuss options available to the student and the possible consequences if the request is acted upon. The GPC will provide the student with a written summary of the discussion, and the student must acknowledge in writing that they understand the implications that may result from a change in major professor. The student has one week following the meeting with the GPC to decide whether to proceed with a change in major professor or request mediation to resolve any conflict with the major professor. All discussions between the student and GPC shall be confidential to this point.

3. If the GPC has explored all the options available and discussed them with the student, the student still wishes to proceed with the request, the GPC will inform the student's current major professor and the Department Chair, then help the student identify a new major professor. The student is expected to be an active participant in this process, including scheduling meetings with prospective new major professors and attending group meetings.

4. Once a new major professor has been assigned to the student, all responsibility for the student's funding, lab space, desk space and advising will be transferred to the new major professor within four weeks.

## Advancing to Candidacy

### Master's Students

Once you have completed the majority of your coursework and have formed your capstone project (M.Eng.) or thesis (M.S.) committee, you can advance to candidacy. You must also have a 3.0 GPA and be in good academic standing. The process for advancing involves filling out a Graduate Studies' advancement to candidacy form.

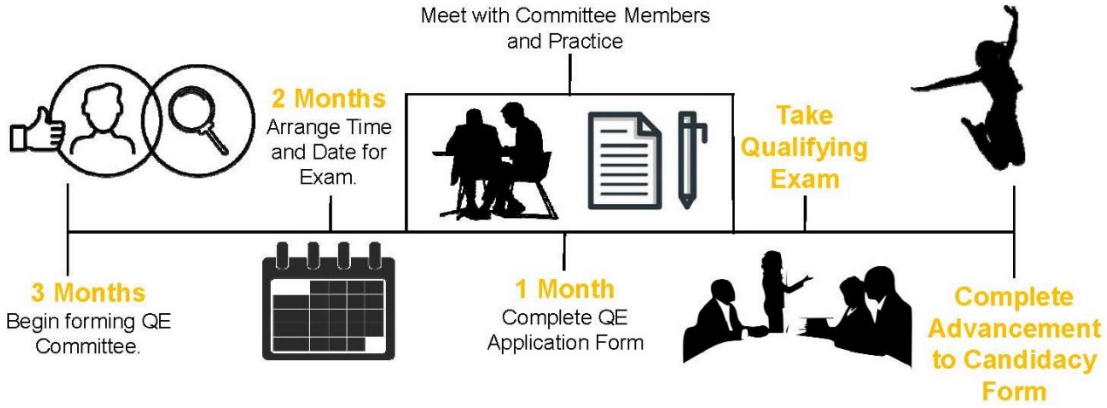
If you need help forming your committee, consult your thesis or capstone project advisor to determine which other faculty would be appropriate additional readers. Committee members do not need to be part of the graduate program faculty or even the university. Your major professor will usually serve as the chair of the committee.

### Doctoral Students

You may advance to candidacy after successfully passing the qualifying exam. You should select your qualifying exam committee in consultation with your major professor, as the major professor cannot serve on this committee. The committee should include

one faculty member from outside the Materials Science and Engineering graduate program.

After determining the committee membership and selecting a chair, you should work with the faculty to determine a mutually agreeable time and date, allowing for the exam to last up to three hours. Once this has been agreed upon, email Debbie Snyder to reserve a room and begin the process of completing the Graduate Studies' qualifying exam application. This form should be completed at least four weeks before the exam date. Prior to the exam, you should meet with your committee members and, if possible, practice your presentation for your lab group members.




Once you pass the qualifying exam, you should advance to candidacy as soon as possible by completing the Candidacy for the Degree of Doctor of Philosophy, Plan B form. Like the master's thesis committee and the qualifying exam committee, students may select a faculty member from outside of the university to serve on the dissertation committee. In most cases, the major professor will serve as the dissertation committee chair.

## Graduation

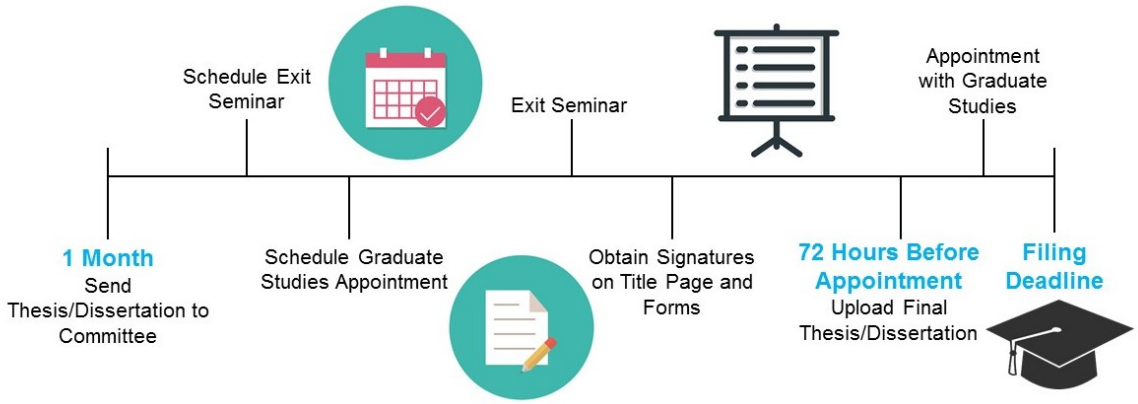
### *Prepare*

In order to graduate in a particular quarter, you need to make sure that you are in good standing and are registered or are in filing fee status. You should have advanced to candidacy at least one quarter before filing to graduate, and you should check to make sure your thesis or dissertation committee is up to date. If you've changed your committee, be sure to fill out a Graduate Studies' reconstitution of committee membership form at least a quarter prior to graduating.

### *Plan*

Planning to file your thesis or dissertation is essential. The filing deadlines posted on the Graduate Studies webpage are a good place to start. Once you know which quarter you want to graduate in, you can determine when you need to start finalizing your dissertation and scheduling your exit seminar. Keep in mind that faculty are allowed at least four weeks for review of the thesis or dissertation.

Once your committee gives you the go-ahead, you should find a mutually agreeable date and time for your exit seminar and schedule it with Debbie Snyder (dsnyder@ucdavis.edU). Then, schedule your Graduate Studies appointment by emailing gradinfo@ucdavis.edu. This appointment should take place after the exit seminar. It's important to review the Graduate Studies candidate degree completion lists for all the forms and surveys you need to complete and bring with you to your appointment. Before you leave UC Davis, be sure to complete the department exit form.




### *Commencement*

Graduate Studies commencement is held once a year in June, separate from the event conducted by the College of Engineering for undergraduate students.

## Registration and Courses

All full-time students should be enrolled in 12 units each quarter to ensure eligibility for employment and access to university services, such as health care. For all Chemical Engineering Engineering degree programs, the core courses should be taken in the first two quarters of enrollment (fall and winter), followed by electives selected in consultation with your major professor or graduate advisor.

We know students are curious about selecting their electives, so we've identified a list of several common electives (also listed in Appendix B). This list should be used to guide your discussion with your major professor. Students often select

electives from the Departments of Chemistry, Physics and other engineering disciplines, as well as from Materials Science and Engineering. Please be sure to complete a program of study (Appendix A) if you haven't already.

If you have identified a major professor and are actively conducting research, use the tool below to locate the course registration number for your major professor. Please take care to ensure that you are enrolled in the correct section of ECH 290, 290C (1 unit for group meeting), and/or 299 (variable units for conducting research).

If you plan to go on a planned educational leave (PELP), contact your graduate program coordinator to complete the necessary paperwork before you register. If you plan to be out of the state for the entirety of the quarter, you should complete an in absentia application and register as normal in 12 units.

## Academic Difficulty

### Academic Probation and Disqualification

The below is a summary of academic probation and disqualification as it relates to the graduate program. Complete information and definitions on academic probation and disqualification can be found on the Graduate Studies website: https://grad.ucdavis.edu/resources/graduate-student-resources/academic-information-and-services/warnings-probation-and

#### *Qualitative*

If a student is not meeting the major professor's expectations for timely progress towards achieving an advanced degree as reflected in unsatisfactory progress reports, the major professor has the right to terminate funding. However, the graduate student should be informed in writing at least one quarter in advance that this being considered, and the student must be informed of the conditions that must be met to avoid termination of funding. Circumstances may arise that require funding to be terminated with less than three months' notice (e.g. change of major professor, gross neglect of graduate studies, Graduate Studies PEP denial). If less than three months' notice is given, the Department Chair and Graduate Program Chair must be apprised by the major professor before such action is taken.

#### *Quantitative*

Graduate students are subject to probation for quantitative reasons by Graduate Studies if the quarterly or cumulative GPA falls below 3.0, or if students accumulate 8 or more units of incomplete (I) or unsatisfactory (U) grades. Students cannot advance to candidacy if they are on academic probation.

#### *Time to Degree*

Doctoral students may be placed on academic probation by Graduate Studies if the dissertation is not submitted within four calendar years from the date they pass the qualifying exam. Further information on this policy may be found on the Graduate Studies

website: https://grad.ucdavis.edu/resources/graduate-student-resources/academic-information-and-services/degree-requirements/normative

## Appendix A – Program of Study

UC DAVIS
CHEMICAL ENGINEERING

# Master of Engineering Program of Study

Student Name:_____

**Core Courses (13 units)**

| Course Number | Units | Quarter | Grade |
|---|---|---|---|
| ECH 200 | 1 | | |
| Choose Three Courses: | | | |
| ECH 252 | 4 | | |
| ECH 253A | 4 | | |
| ECH 253C | 4 | | |
| ECH 256 | 4 | | |
| ECH 259 | 4 | | |

**Elective Courses (23 units)**

| Course Number | Units | Quarter | Grade |
|---|---|---|---|
| ECH 290 | 1 | | |
| ECH 290 | 1 | | |
| ECH 299 | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Notes:

_____

Major Professor Date

_____

Graduate Program Coordinator Date

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CHEMICAL ENGINEERING

# MS Plan I (Thesis) Program of Study

Student Name:_____

☐ **Core Courses (20/21 units)**

| Course Number | Units | Quarter | Grade |
|---|---|---|---|
| ECH 200 *(Fall 2019 and later)* | 1 | | |
| ECH 252 | 4 | | |
| ECH 253A | 4 | | |
| ECH 253C | 4 | | |
| ECH 256 | 4 | | |
| ECH 259 | 4 | | |

☐ **Elective Courses**

***Fall 2019 and later (12 units)***

| Course Number | Units | Quarter | Grade |
|---|---|---|---|
| ECH 290 | 1 | | |
| ECH 290 | 1 | | |
| | | | |
| | | | |
| | | | |
| | | | |

*No ECH 299 units may be used towards this requirement.*

***Fall 2018 and earlier (16 units)***

| Course Number | Units | Quarter | Grade |
|---|---|---|---|
| ECH 299 | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

*ECH 290 should be taken all quarters in residence.*

Notes:

_____

Major Professor Date

_____

Graduate Program Coordinator Date

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CHEMICAL ENGINEERING

# Program of Study for Doctoral Candidates

Name:_____

Please indicate which degree requirements you will be following:

- ☐ **October 2018 Degree Requirements**
- ☐ **1999 Degree Requirements**

**Core Courses (21 units) or Major Courses (26 units)**

| Course Number | Title | Quarter | Units | Grade |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Total Units _____

**Electives (16 units) or Minor (12 units)**

| Course Number | Title | Quarter | Units | Grade |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Total Units _____

Notes:

_____

Major Professor Signature Date

_____

Graduate Coordinator Signature Date

## Appendix B- Recommended Electives

The electives listed below are a few recommended classes to help you and your major professor guide your coursework to complement your research objectives, though it is in no way a comprehensive list of all the courses available. The list will be updated annually with any new courses approved by major professors and graduate advisors.

### *Biological Focus*

BCB 211: Macromolecule Structures and Interactions (3 units)
BIM 202: Cell and Molecular Biology for Engineers (4 units)
BIM 214: Cell Mechanics (4 units)
BIM 262: Molecular Biophysics (4 units)
BIM 289A: Cellular and Molecular System Engineering (4 units)
EBS 270: Modeling Biosystems (3 units)
ECH 206: Biochemical Engineering (3 units)
ECH/EMS 245: Micro- and Nano-Technology in Life Sciences (4 units)
ECH 246: Advanced Biochemical Engineering (2 units)
ECH 269: Cell and Molecular Biophysics for Bioengineers (4 units)
EMS 288: Physical Biology of Cells (4 units)

### *Biotechnology*

BIT 160: Plant Biotechnology (3 units)
BPH 241: Membrane Biology (3 units)
PLP 123: Plant-Virus Vector Interactions (3 units)

### *Chemical Engineering*

ECH/EMS 246: Photovoltaics and Solar Cells (3 units)
ECH 253B: Advanced Heat Transport (4 units)
ECH 254: Colloid and Surface Phenomena (4 units)
ECH 261: Molecular Modelling of Soft and Biological Matter (4 units)
ECH 262: Transport Phenomena in Multiphase Systems (3 units)
ECH 264: Emulsions, Microemulsions, and Bilayers (4 units)

### *Chemistry*

CHE 210A: Quantum Chemistry (3 units)
CHE 210B: Quantum Chemistry (3 units)
CHE 222: Chemistry of Nanoparticles (3 units)
CHE 226: Principles of Transition Metal Chemistry (3 units)

### *Civil Engineering*

ECI 205: Continuum Mechanics (3 units)
ECI 241: Environmental Reactive Chemical Transport Modeling (3 units)
ECI 247L: Aerosols Laboratory (4 units)
ECI 253: Dynamic Programming and Multistage Decision Processes (4 units)
ECI 267: Water Resource Management (3 units)

### *Computational*

CHE 204: Mathematical Methods in Chemistry (3 units)
ECH 261: Molecular Modeling (4 units)
ECS 230: Application Numerical Linear Algebra (4 units)
EEC 250: Linear Systems and Signals (4 units)
MAT 207C: Applied Mathematics (4 units)

MAT 226A: Numerical Methods (4 units)
MAT 226B: Matrix Computation (4 units)
MAT 258A: Numerical Optimization (4 units)

*Engineering Education*
ECI 289C: Engineering Education Lesson Design I (2 units)

*Fiber and Polymer Science*
FPS 250A-F: Special Topics in Polymer Fiber Science (4 units)

*Fluid Mechanics*
MAE 210A: Advanced Fluid Mechanics and Heat Transfer (4 units)
MAE 210B: Advanced Fluid Mechanics and Heat Transfer (4 units)

*Food and Beverage*
ABG 250: Modeling in Biological Systems (3 units)
EBS 265: Design and Analysis in Engineering Experiments (5 units)
ECH 226: Enzyme Engineering (3 units)
ECH 265: Emulsions, MIcroemulsions, and Bilayers (3 units)
ETX 220: Analysis of Toxicants (3 units)
FST 202: Physical Chemistry of Foods (3 units)
FST 211: Lipids (3 units)
MIC 170: Yeast Molecular Genetics (3 units)
VEN 215: Sensometrics (3 units)
VEN 224: Advances in Winemaking (3 units)

*Imaging and Spectroscopy*
BIM 289B: Biomedical Imaging (4 units)
CHE 205: Spectroscopy (3 units)
CHE 216: Magnetic Resonance Spectroscopy (3 units)
CHE 217: X-Ray Structrual Deter (3 units)
CHE 240: Advanced Analytical Chemistry (3 units)
CHE 241B: Laser and X-Ray Spectroscopy (3 units)
CHE 241E: Microscopy and Imaging (3 units)
EMS 230: Fundamentals of Electron Microscopy (3 units)
EMS 230: Electron Microscopy Lab (2 units)

*Management*
MGT 290: Topics in General Management (3 units)

*Materials Science*
EMS 248: Fracture of Engineering Materials (3 units)
EMS 249: Fatigue Mechanisms (3 units)
EMS 260: Advanced Thermodynamics of Solids (4 units)
EMS 262: Advanced Structural Properties of Materials (4 units)
EMS 272: Advanced Functional Properties of Materials (4 units)
EMS 274: Advanced Mechanical Properties of Materials (4 units)
EMS 288: Glass – Science and Technology (4 units)
MAE 250C: Mechanical Performance of Materials (4 units)

PHY 108: Optics (3 units)
PHY 110C: Electricity and Magnetism (3 units)
PHY 240A: Condensed Matter Physics A (3 units)
PHY 240B: Condensed Matter Physics B ( 3 units)
PHY 243B: Surface Physics (3 units)
PHY 250: Special Topics (3 units) (Topic varies by instructor)

*Nuclear Science*

BIM 243: Radiation Detectors in Biomedical Applications (4 units)
GEL 227: Stable Isotope Biogeochemistry (4 units)
GEL 251: Advanced Topics in Isotope Geochemistry and Cosmochemistry (3 units)
PHY 224A: Nuclear Physics (3 units)
PHY 245A: High-Energy Physics (3 units)
PHY 252B: Techniques of Experimental Physics (3 units)

*Process Control*

ECH 267: Advanced Process Control (3 units)
EEC 263: Optimal and Adaptive Filtering (4 units)
MAE 272: Theory Design Control Systems (4 units)
TTP 289A: Selected Topics in Transportation (3 units)

*Thermodynamics*

ECH 252: Statistical Thermodynamics (4 units)
EMS 244: Interaction of Materials and their Environment (3 units)