

Fall 2020 Course Descriptions as of 04/05/2020 08:10 PM

Information in Browse Course Catalog is subject to change. Information is term specific. Please refer to the appropriate term when searching for course content. Key to Course Descriptions may be found at: http://rcs.registrar.arizona.edu/course_descriptions_key.

Chemical & Environmental Engr (CHEE)

CHEE 199: Independent Study (1 - 4 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CHEE 201: Elements of Chemical & Environmental Engineering I (3 units)

Description: Chemical engineering and environmental engineering calculations and principles of energy and material behavior.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Discussion	Required
	Lecture	Required

Course typically offered:

Main Campus: Fall

Enrollment requirement: (MATH 122B or MATH 125) and completion or concurrent enrollment MATH 129 and [CHEM 152 or (Honors CHEM 105B and 106B)].

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 201L: Elements of Chemical & Environmental Engineering I - Computational Lab (1 unit)

Description: This course will also begin demonstrating how mathematics and programming can be fundamental tools for solving complex engineering problems. Specifically, students will learn how to use Visual Basic implemented in Excel to program solutions for mathematically intractable problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory Required

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MATH 129, CHEM 152 and PHYS 141. Co-req enrollment in and MATH 223 or 254.

Enrollment requirement: AME 105 and concurrent enrollment or completion of AME 205.

CHEE 202: Elements of Chemical and Environmental Engineering II (4 units)

Description: This course will introduce you to the fundamental principles of chemical process analysis. It will equip you with problem solving techniques and will give you experience in the application of these techniques to a wide variety of process-related problems. This course will also begin demonstrating how mathematics and spreadsheets can be a fundamental tool for solving complex engineering problems, including the solving of transient material and energy balances.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Discussion Required
Lecture Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: CHEE 201 and CHEE 201L. Prerequisite or concurrent registration in MATH 254.

CHEE 203: Chemical Engineering Heat Transfer and Fluid Flow (3 units)

Description: Introduction to fluid mechanics and heat transfer applied to chemical engineering.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: CHEE 201 and PHYS 141.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Where does the energy come from to light a building or power an air conditioning system? Where does the water in your facet originate and what treatment/processing has been required? Where does the water go when you flush the toilet or drain a bathtub? How do we distribute water and energy from central facilities to individual homes and businesses? How do we avoid running out of water and energy for urban use? This course will provide the fundamental information on water and energy systems and provide students with a broad education as to the past, present, and future considerations for sustainable water and energy system technologies. Human population growth and increasing urbanization are stressing conventional water and energy resources. Sustainability will require the continued exploration of renewable and alternative sources of water and energy. In addition, water and energy systems are intrinsically and symbiotically related. This course will explore the history, present, and future of these systems with an emphasis on the technologies for alternative energy and water. Key areas for discussion will include atomic, solar, hydro, and wind energy system technologies, as well as water reuse and desalination. Through this course, students will become familiar with the primary sources of water and energy and the systems and technologies used for production and conveyance. The course will discuss how water and energy systems have developed and will evolve using case studies in each section of the class. Scenario discussions will debate pros and cons of each approach including cost, feasibility, and sustainability. Students completing this course will gain a strong understanding of the water and energy systems used to sustain urban growth and development, as well as a vision of the future related to challenges and potential solutions for sustainability. Course not acceptable as a technical elective or an engineering elective for engineering majors.

Career: Undergraduate

Required

Main Campus: Spring

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 270: Introduction to Environmental Engineering (1 - 2 units)

Description: This course provides an introduction to the field of environmental engineering by examining both environmental processes and environmental systems. Topics addressed include air quality, water quality, solid and hazardous waste, risk assessment, and sustainable technology. The course balances a broad overview of environmental engineering with an in-depth investigation of selected environmental problems and technologies. An emphasis is placed on understanding the fundamental scientific principles that serve as the basis of environmental engineering applications. Methods for quantitative analysis of environmental systems are developed.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Recommendations and additional information: CHEE 201 and (CHEM 241A or 242A or 246A) and (CHEM 243A or 247A)

CHEE 291: Preceptorship (1 - 3 units)

Description: Specialized work on a individual basis, consisting of instruction and practice in actual service to a department program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work, and patient study.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Students must have passed the class in which they are serving as a preceptor with a grade of C or higher and be interested in teaching. Students will be expected to attend training sessions during the week prior to the start of the semester.

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-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 295E: Careers in Environmental Engineering (1 unit)

Description: The main course objective is to familiarize students with the possible careers in the environmental engineering field. The course is provided in colloquium style and designed to help students understand career opportunities for Environmental Engineers (EEN). Students will interact with invited speakers and explore various roles of EEN in solving real environmental engineering problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Colloquium Required

Course typically offered:

Main Campus: Fall

Field trip: One trip to a Waste Water Treatment Center in Pima County and Mission Mine re-vegetation Process in Green Valley.

CHEE 299: Independent Study (1 - 5 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CHEE 299H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall

Enrollment requirement: Student must be active in the Honors College.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 300: Introduction to Water Chemistry for Engineers (3 units)

Description: Introduction to environmental chemistry, equilibrium aquatic chemistry, chemical thermodynamics and introduction to acid-base equilibria, and redox chemistry. Includes software to solve aquatic chemical equilibrium problems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Field trip: No

CHEE 301A: Chemical Engineering Lab I (1 unit)

Description: Laboratory and computational exercises on basic chemical engineering processes.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory	Required
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Lecture	Required
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Course typically offered:

Main Campus: Fall

Recommendations and additional information: CHEE 202, CHEE 203, MATH 254.

Corequisite course: CHEE 303, CHEE 402.

Enrollment requirement: Adv Stdg: Engineering and CHEE 203.

CHEE 301B: Chemical Engineering Lab II (1 unit)

Description: Laboratory on transport phenomena, thermodynamics and mass transfer operations.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$60

Course Components:	Laboratory	Required
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Lecture	Required
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Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering. Pre-requisites: CHEE 301A and CHEE 303.

Co-requisite:CHEE 305 and 326.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: This course is specifically designed to support campus, and future industrial and public, efforts on achieving carbon neutrality so that sustainability will not be impaired by global climate change. Students will learn about life cycle assessment, carbon footprints, and the definitions needed in order to support evaluations in both arenas. The course is intended to provide students with the background that they could use their science, business, or engineering background to perform the data collection and accounting procedures with justification from published or high quality sources to evaluate current and future practices. Students will also receive training and build skills in how to use persuasive arguments based on not only reducing footprint but also enhancing financial benefits that will help support them in achieving sustainable practices in their future careers. An illustrative example using a campus facet will help ground the course in real-world problems and details so that students can learn how to handle the issues that arise.

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering. CHEE 202 or CHEM 480A or AME 230.

Description: Introduction to mass transfer analysis of mass transfer operations in chemical engineering, such as distillation, absorption.

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering and CHEE 203.

Description: Theory and calculations pertaining to fundamental transport processes.

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Spring

Enrollment requirement: CHEE 303 and CHEE 402.

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 326: Chemical and Physical Equilibrium (3 units)

Description: Applications of thermodynamics to equilibrium processes; chemical and physical equilibrium in multicomponent systems.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering. CHEE 303 and CHEM 480A.

CHEE 370L: Environmental and Water Engineering Laboratory (1 unit)

Description: The course is supplementary to CHEE/CE 370R, the three-unit introductory environmental engineering course. Basically, it consists of a 1-unit, problem-oriented lab that meets two hours per week to provide supplementary material for non chemical engineers taking the introductory course. Emphasis will be on introducing chemistry and biochemistry concepts that support environmental engineering operations for water and wastewater treatment. Basic problem solving skills in these areas will also be developed.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Laboratory Required

Equivalent to: CE 370L

Also offered as: CE 370L

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Not open to Chemical Engineering students.

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 370R: Environmental and Water Engineering (3 units)

Description: Covers principles and methods for analysis of environmental engineering issues. Includes such topics as greenhouse gas effects, tropospheric air pollution, environmental air pollution, environmental risk assessment, surface and ground water pollution and drinking and wastewater treatment.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 370, CE 370R, CHE 370, CHEE 370

Also offered as: CE 370R

Course typically offered:

Main Campus: Spring

Recommendations and additional information: CHEE 201 and (CHEM 241A or CHEM 242A or CHEM 246A) and (CHEM 243A or CHEM 247A) or Engineering Advanced Standing.

Enrollment requirement: (CHEE 201 and (CHEM 241A or CHEM 242A or CHEM 246A) and (CHEM 243A or CHEM 247A)) or Advanced Standing.

Special Exam: Special Exam Credit Only

CHEE 377: Microbiology for Engineers (3 units)

Description: This course focuses on the principles of microbiology, including physiology, metabolism, genetics and ecology. The course explores fundamental microbial processes as well as their environmental significance and application in environmental engineering

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Field trip: None

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 391: Preceptorship (1 - 3 units)

Description: Specialized work on a individual basis, consisting of instruction and practice in actual service to a department program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work, and patient study.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Students must have passed the class in which they are serving as a preceptor with a grade of C or higher and interested in teaching. Students will be expected to attend training sessions during the week prior to the start of the semester.

Enrollment requirement: Adv Stdg: Engineering.

CHEE 399: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

CHEE 399H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Stdg: Engineering. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 400A: Environmental Engineering Laboratory I (1 unit)

Description: This laboratory experience focuses on unit operations and processes commonly applied in environmental engineering and supports fundamental concepts developed in required courses for Environmental Engineering majors.. Individual and group reports and oral presentations will serve as vehicles for the development of technical communications skills. Two and a half hours of laboratory per week during 5 weeks.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$40

Course Components:	Laboratory	Required
	Lecture	May Be Offered

Co-convened with: CHEE 500A

Course typically offered:

Main Campus: Fall

Enrollment requirement: CHEE 370R or CHEE 478 or CHEE 476A or CHEE 476B.

CHEE 400B: Environmental Engineering Laboratory II (1 unit)

Description: This laboratory experience focuses on unit operations and processes commonly applied in environmental engineering and supports fundamental concepts developed in required courses for Environmental Engineering majors. Individual and group reports and oral presentations will serve as vehicles for the development of technical communications skills. Two and a half hours of laboratory per week during 5 weeks.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering. CHEE 370R and (CHEE 400A or CHEE 478 or CHEE 476A, or CHEE 476B).

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 400R: Water Chemistry for Engineers (3 units)

Description: The course provides an introduction to primarily aqueous-phase equilibria governing water quality characteristics of interest in portable water supply, wastewater treatment and natural waters. Specific topics covered include acid-base and metal-ligand equilibria, oxidation-reduction reactions and chemical reaction thermodynamics. There is some emphasis on equilibria governing inter-phase (gas-liquid, solid-liquid) chemical distribution. Mathematical approaches to prediction of equilibrium chemical speciation are stressed.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CHEE 400

Co-convened with: CHEE 500R

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering.

CHEE 401A: Chemical and Environmental Engineering Laboratory I (1 unit)

Description: Laboratory of environmental engineering operations.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory	Required
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Lecture	Required
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Co-convened with: CHEE 501A

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering. Pre-requisite: CHEE 301B. Co-requisite: CHEE 420

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 401B: Process Dynamics and Control Laboratory (1 unit)

Description: The purpose of this laboratory is to learn how to acquire data from instruments and use it in process control. You will build simple apparatus including sensors that output analog signals. Conditioning the signals and converting them into digital form, will allow you to work with and store the data on a computer. You will write programs using Matlab and LabVIEW to acquire and analyze the data and output a signal to another instrument to control a process.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$30

Course Components:	Laboratory	Required
	Lecture	Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering. CHEE 301A, CHEE 301B, and CHEE 401A.
Prerequisite or concurrent registration in CHEE 413.

CHEE 402: Chemical Engineering Modeling (3 units)

Description: Solution of complex chemical engineering problems utilizing both analytical and numerical techniques.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall

Recommendations and additional information: Concurrent registration, CHEE 303.

Enrollment requirement: Adv. Stdg: Engineering. CHEE 202, MATH 254, and AME 205.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 412: Electrochemical Engineering (4 units)

Description: This course is suited to people with a physical sciences background who have not been trained as electrochemists, but who want to add electrochemical methods to their repertoire. There are many disciplines in which it would be advantageous to understand and use some electrochemical methods to complement the work that they are doing. The following topics will be covered: ∫ Introduction and Overview of Electrode Processes ∫ Chemical vs. Electrochemical Thermodynamics o cell potentials, Nernst equation, electrode-solution interface, double-Layer structure, and adsorption o applications in analytical electrochemistry and sensors ∫ Chemical Stoichiometry vs. Faraday's Law o coulometry, bulk electrolysis ∫ Chemical vs. Electrochemical Kinetics o electrode reactions, rates, mechanisms and rate constants, mass transport, Butler-Volmer, Tafel, and Levich equations ∫ Kinetic Methodology o potential step and sweep methods, polarography, controlled-current techniques, controlled mass transport approaches, rotating electrodes, microelectrodes, electrochemical impedance spectroscopy ∫ Electrochemical Instrumentation o voltmeters, potentiostats, cells, counter and reference electrodes, etc. Also included, if time permits: ∫ Coupled Characterization Methods o modified electrodes, spectroelectrochemistry, in-situ neutron scattering, surface analysis, etc. ∫ Scanning Probe Techniques o scanning electrochemical microscopy, AFM, etc.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$50

Course Components:	Laboratory	Required
	Lecture	Required

Co-convened with: CHEE 512

Course typically offered:

Main Campus: Fall

Recommendations and additional information: CHEE 202 and CHEM 480A, or equivalent courses .

CHEE 413: Process Control and Simulation (3 units)

Description: Theory of automatic control as applied to elementary chemical engineering processes. Use of continuous system simulation languages for study of practical control problems in the process industries.

Grading basis: Regular Grades

Career: Undergraduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Spring

Recommendations and additional information: Concurrent enrollment with CHEE 401B is required.

Enrollment requirement: Adv Stdg: Engineering. CHEE 401A and CHEE 420

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 436: Engineering Innovation (3 units)

Description: Many small advances often create major technological breakthroughs that are commercial successes: integrated circuits, DNA sequencing, and charge-coupled devices are some examples. This course will examine engineering innovation in three stages by 1) dissecting past breakthroughs to show how they work and how they came into existence at a particular time and place, 2) preparing a case study on a current technology to build a framework of what to look for, and 3) applying this framework to a technology on the horizon to determine what its potential might be. The course will be of interest to students from all of the engineering and science disciplines as well as students in the humanities who have some science background and a strong interest in how technological innovation happens.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Also offered as: ENGR 436, ENTR 436

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering.

CHEE 437: Surface Science (3 units)

Description: Fundamental material, electrical, and chemical properties of solid metal, semiconductor, insulator, and organic surfaces applied to selected gas/solid surface chemical reactions important in semiconductor processing and heterogeneous catalysis. This course is designed to introduce students to the chemistry and physics of solid surfaces and interfaces with an emphasis on the gas/solid interface. The first half of the course will be devoted to learning the fundamental material, electrical, and chemical properties of solid surfaces. The fundamentals will be applied in the second half of the course to topics in chemical catalysis and integrated circuit manufacture.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CHEM 437, MSE 437

Also offered as: CHEM 437, MSE 437

Co-convened with: CHEE 537

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering or major or minor in Chemistry, Physics or Optical Sciences. Junior or Senior status.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 442: Chemical Engineering Design Principles (3 units)

Description: Preliminary economic, environmental, safety and design principles associated with chemical process equipment.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Fall

Enrollment requirement: CHEE 303 and completion or concurrent enrollment CHEE 402.

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

CHEE 443: Chemical Engineering Plant Design (3 units)

Description: Design project from scoping and process selection, through material and energy balances, equipment design and sizing, safety and environmental considerations, to economic analysis of capital cost and operating expense.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering. CHEE 442.

Student Engagement Activity: Discovery

Student Engagement Competency: Innovation and Creativity

CHEE 473: Biodegradation of Hazardous Organic Compounds (3 units)

Description: To learn and integrate the basic principles of microbiology required for understanding of application of bioremediation to contaminated sites. To become familiar with current research in bioremediation. To learn to solve problems often encountered in application of bioremediation.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 473

Also offered as: CE 473

Co-convened with: CHEE 573

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Processes affecting mass transfer and transformation in natural and engineered environmental systems. Process modeling using reactor models. Mass transfer kinetics and equilibrium. Mass and energy balances.

Career: Undergraduate

Co-convened with:

Course typically offered:

Main Campus: Fall

CHEE 476A: Water Treatment System Design (3 units)

Description: Application of theory and engineering experience to the design of unit operations for the production of potable water. Covers water regulations, conventional treatment technologies and selected advanced treatment topics.

Career: Undergraduate

Equivalent to: CE 476A

Also offered as: CE 476A

Co-convened with: CHEE 576A

Course typically offered:

Main Campus: Fall

Recommendations and additional information: Recommend that Civil Engineering students take CE 370R and CE 370L prior to enrolling in CE 476A.

Enrollment requirement: Adv Stdg: Engineering.

Description: Application of theory and engineering experience to the design of unit operations for the treatment of wastewater. Covers water regulations, conventional treatment technologies and selected advanced treatment topics.

Career: Undergraduate

Equivalent to: CE 476B

Also offered as: CE 476B

Co-convened with: CHEE 576B

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering.

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 477R: Microbiology for Engineers (3 units)

Description: This course focuses on the principles of microbiology, including physiology, metabolism, genetics and ecology. The course explores fundamental microbial processes as well as their environmental significance and application in environmental engineering. A laboratory is associated with the lecture course to provide laboratory skills in basic and applied microbiology.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CHEE 577R

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering.

CHEE 478: Introduction to Hazardous Waste Management (3 units)

Description: Management, planning, legal and engineering aspects of liquid and solid hazardous waste treatment and disposal.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: CE 478

Also offered as: CE 478

Co-convened with: CHEE 578

Course typically offered:

Main Campus: Spring

Recommendations and additional information: Consult department before enrolling.

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 481A: Engineering of Biological Processes (3 units)

Description: To learn to apply to the design of biological systems principles of engineering, science and mathematics, including, but not limited to statistics, kinetics, sensors and bioreactor design and scale up. To explore and be familiar with the principal areas of biological engineering such as food process engineering, tissue engineering, and other large-scale fermentation processes.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Equivalent to: ABE 481A

Also offered as: BE 481A

Co-convened with: CHEE 581A

Course typically offered:

Main Campus: Fall

Recommendations and additional information: MATH 254 and MCB 182 or MIC 205A or CHEE 450 or instructor consent.

Enrollment requirement: Adv Stdg: Engineering.

CHEE 481B: Cell and Tissue Engineering (3 units)

Description: Development of biological engineering methods including applied genetics, metabolic regulation, and bioreactors employed in industrial processes for manufacture of pharmaceuticals and in the design of tissue engineered devices to replace normal physiological function.

Grading basis: Regular Grades

Career: Undergraduate

Flat Fee: \$100

Course Components: Laboratory May Be Offered
Lecture Required

Equivalent to: BME 481B, CHEE 481B

Also offered as: BE 481B, BME 481B

Co-convened with: CHEE 581B

Course typically offered:

Main Campus: Spring

Home department: Biomedical Engineering

Enrollment requirement: Adv. Stdg: Engineering. Junior or Senior status. MATH 254

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 482: Analysis of Emerging Environmental Contaminants (3 units)

Description: Contaminants of emerging concern (CECs) have become major scientific and political issues. Many of these environmental contaminants have been detected in air, water, soil, and/or biota. Most CECs are identified and quantified based on non-standardized methods, often with limited or questionable quality assurance and quality control. At times, public policy and resource allocation are based on these uncertain data. Moreover, there are thousands of potential contaminants for which no analytical methodologies have yet been developed. Through this course, students will become familiar with the diversity of analytical (instrumental) and bioanalytical (bioassays) tools currently available, and will gain knowledge as to the pros and cons of each approach. The class also will discuss future opportunities, such as development of on-line sensors and miniaturization of environmental methods. While the emphasis of the course will be on water analysis, the class will also briefly discuss implications for other environmental matrices such as biosolids, sediments, solids, tissues, body fluids, and aerosols. Contaminants will be discussed in terms of classes (i.e., pharmaceuticals, steroid hormones, nanoparticles, metals, disinfection byproducts) as well as physical chemical properties (i.e., water solubility, acid/base, volatility, molecular weight, molecular geometry). This class will provide a hands-on experience with the key instrument platforms such as gas chromatography with mass spectrometric detection, inductively coupled plasma with mass spectrometric detection, liquid chromatography with diode array UV, fluorescence, and mass spectrometric detection. Instruction on select instrumental software platforms will also be demonstrated and basic integration, calibration, and data export will be discussed. Cellular and whole animal bioassays for the screening of complex mixtures of contaminants will be discussed and demonstrated. The key principals of toxicity identification and evaluation (TIE) will be covered in this class, along with real world examples of how TIE is used to determine causes of observed environmental toxicity. Students will work independently and as groups to investigate a key issue relative to environmental analysis, write a paper on this topic, and present and defend their findings before the class.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CHEE 582

Course typically offered:

Main Campus: Spring

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 483: Introduction to Polymeric Materials (3 units)

Description: The aim of this course is to develop a working understanding of the foundations of polymeric materials. Successful completion of this course will allow you to understand basic polymer chemistry, characterization of polymers, and polymer behavior. Topics covered include the structure of polymers, mechanisms of polymer synthesis, characterization methods (including calorimetric, mechanical, rheological, and X-ray-based techniques), and their electronic, mechanical, and thermodynamic properties. Special classes of polymers: engineering plastics, semiconducting polymers, photoresists, and polymers for medicine.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CHEE 583

Course typically offered:

Main Campus: Fall

Field trip: None

Enrollment requirement: Advanced standing for engineering students, or senior standing for non-engineering students (must have at least 90 units). CHEM 151/152 or CHEM 141 + 143/142 + 144 or CHEM 161/162, PHYS 141 or PHYS 161H.

CHEE 487: Topics in Transport Phenomena (3 units)

Description: Special topics in transport phenomena oriented towards practical applications in specific industrial and research areas. Topics include the dynamics of non-Newtonian fluids, thermal radiation, transport in multiphases systems, design of fluid transport systems, atmospheric transport, and mechanics of interfaces.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Co-convened with: CHEE 587

Course typically offered:

Main Campus: Spring

Enrollment requirement: Advanced standing in Engineering, and CHEE 305.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 489: Trends in Nanomedicine Engineering - Fundamentals of Therapeutics and Drug Delivery Systems (3 units)

Description: Nanomedicine engineering research involves the advance of diagnostics for rapid screening and monitoring, controlled and localized drug delivery, targeted cancer therapies, enhanced cell material interactions, scaffolds for tissue engineering, and gene delivery systems amongst others. Developments in nanomedicine engineering to effectively benefit patients require the interaction of diverse disciplines including chemistry, biochemistry, biophysics, engineering, materials science, cellular and molecular biology, pharmaceutical sciences and clinical translational medicine. This interdisciplinary course will address how materials are fabricated, characterized and interact in biological systems. The emphasis of the course will be in the application of therapeutics and controlled release drug delivery systems. Integration of biomaterial nanostructures and release analysis will be highlighted throughout the course. Through lectures, paper reviews, class discussions, experimental lab exposure, class presentations and homework assignments, students will develop an in depth understanding of the various ways nanoparticles have been used as diagnostics tools, in advancing tissue engineering and in how drug delivery systems can be improved to overcome the problems associated with typical oral and intravenous administration. Several types of drug and gene delivery methods including oral, transdermal, implantable, targeted and pulmonary will be discussed. The course will highlight the rational design of drug delivery devices based on the fundamental understanding in engineering, pharmacology, chemistry and biomaterials science.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Enrollment requirement: Advanced Standing: Engineering. Junior, Senior, or Graduate standing. MATH 254 and (CHEM 481 or [CHEM 480A and 480B] or [BIOC 462A and 462B]).

CHEE 491: Preceptorship (1 - 3 units)

Description: Specialized work on an individual basis, consisting of instruction and practice in actual service to a department program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work, and patient study.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Spring

Recommendations and additional information: Students must have passed the class in which they are serving as preceptor with a grade of C or higher and be interested in teaching. Students will be expected to attend training sessions during the week prior to the start of the semester.

Enrollment requirement: Adv Stdg: Engineering.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 497: Workshop (3 units)

Description: The practical application of theoretical learning within a small group setting and involving an exchange of ideas and practical methods, skills, and principles.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Workshop Required

Repeatable: Course can be repeated a maximum of 2 times.

Co-convened with: CHEE 597

Course typically offered:

Main Campus: Fall

Enrollment requirement: Adv Stdg: Engineering.

CHEE 499: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Alternative Grading: S, P, F

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

Enrollment requirement: Adv Stdg: Engineering.

CHEE 499H: Honors Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work.

Grading basis: Regular Grades

Career: Undergraduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring

Enrollment requirement: Adv Stdg: Engineering. Honors active.

Honors Course: Honors Course

Honors Course: Honors Course

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 500A: Environmental Engineering Laboratory I (1 unit)

Description: This laboratory experience focuses on unit operations and processes commonly applied in environmental engineering and supports fundamental concepts developed in required courses for Environmental Engineering majors. Individual and group reports and oral presentations will serve as vehicles for the development of technical communications skills. Two and a half hours of laboratory per week during 5 weeks.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$40

Course Components:	Laboratory	Required
	Lecture	May Be Offered

Co-convened with: CHEE 400L

Course typically offered:

Main Campus: Fall

CHEE 500R: Water Chemistry for Engineers (3 units)

Description: The course provides an introduction to primarily aqueous-phase equilibria governing water quality characteristics of interest in portable water supply, wastewater treatment and natural waters. Specific topics covered include acid-base and metal-ligand equilibria, oxidation-reduction reactions and chemical reaction thermodynamics. There is some emphasis on equilibria governing inter-phase (gas-liquid, solid-liquid) chemical distribution. Mathematical approaches to prediction of equilibrium chemical speciation are stressed. Graduate-level requirements include the application of canned computer algorithms to solve equilibrium chemistry problems.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: CHEE 400R

Course typically offered:

Main Campus: Spring

CHEE 502: Advanced Engineering Analysis (3 units)

Description: Process modeling techniques, residence time distribution theory, dynamics of distributed parameter systems, nonlinear parameter estimation.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Course typically offered:

Main Campus: Fall

Recommendations and additional information: CHEE 420.

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 512: Electrochemical Engineering (4 units)

Description: This course is suited to people with a physical sciences background who have not been trained as electrochemists, but who want to add electrochemical methods to their repertoire. There are many disciplines in which it would be advantageous to understand and use some electrochemical methods to complement the work that they are doing. The following topics will be covered: ∫ Introduction and Overview of Electrode Processes ∫ Chemical vs. Electrochemical Thermodynamics o cell potentials, Nernst equation, electrode-solution interface, double-Layer structure, and adsorption o applications in analytical electrochemistry and sensors ∫ Chemical Stoichiometry vs. Faraday's Law o coulometry, bulk electrolysis ∫ Chemical vs. Electrochemical Kinetics o electrode reactions, rates, mechanisms and rate constants, mass transport, Butler-Volmer, Tafel, and Levich equations ∫ Kinetic Methodology o potential step and sweep methods, polarography, controlled-current techniques, controlled mass transport approaches, rotating electrodes, microelectrodes, electrochemical impedance spectroscopy ∫ Electrochemical Instrumentation o voltmeters, potentiostats, cells, counter and reference electrodes, etc. Also included, if time permits: ∫ Coupled Characterization Methods o modified electrodes, spectroelectrochemistry, in-situ neutron scattering, surface analysis, etc. ∫ Scanning Probe Techniques o scanning electrochemical microscopy, AFM, etc. Graduate-level requirements include course project topic selection, corresponding summary and annotated bibliography, and detailed outline. During the second half of the semester each graduate student will present their course project topic in class as a 20 minute talk. In November/December graduate students are expected to present their course project (50% of grade).

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$50

Course Components:	Laboratory	Required
	Lecture	Required

Co-convened with: CHEE 412

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: This 4-credit hour course is designed to be the capstone of the Food, Energy and Water Systems minor (FEWS) in engineering, although the course is open to all graduate students. The course focuses on the "water" aspect of the minor, as well as tying in the rest of the subjects into a design project. The course will be a mixture of lecture and project-based learning. Topics to be covered are: regulatory approaches to water quality, water engineering, water issues specifically in Arizona, and a final design project

Main Campus: Spring

Field trip: None

Main Campus: Fall

Main Campus: Fall

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 525: Emerging Issues in Water Quality (3 units)

Description: This course will investigate, discuss, and debate major emerging water quality issues which threaten our water sustainability and the regulatory paradigms to address these challenges.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

CHEE 530: Advanced Chemical Reaction Engineering (3 units)

Description: Kinetics of heterogeneous reaction systems, non-ideal flow reactor models, reactor stability, analysis of industrial reactors.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

Recommendations and additional information: CHEE 420.

CHEE 535: Corrosion and Degradation (3 units)

Description: The science of corrosion and degradation reactions and its application to engineering problems. Graduate-level requirements include a term paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CHE 535, CHEE 535

Also offered as: MSE 535

Co-convened with:

Course typically offered:

Main Campus: Fall (odd years only)

Home department: Materials Science & Engineering

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: Fundamental material, electrical, and chemical properties of solid metal, semiconductor, insulator, and organic surfaces applied to selected gas/solid surface chemical reactions important in semiconductor processing and heterogeneous catalysis. This course is designed to introduce students to the chemistry and physics of solid surfaces and interfaces with an emphasis on the gas/solid interface. The first half of the course will be devoted to learning the fundamental material, electrical, and chemical properties of solid surfaces. The fundamentals will be applied in the second half of the course to topics in chemical catalysis and integrated circuit manufacture. Graduate-level requirements include completion of two projects of their choice with the approval of the instructor.

Career: Graduate

Equivalent to: CHEM 537, MSE 537

Co-convened with: CHEE 437

Course typically offered:

Main Campus: Spring

Description: This course focuses on biological remediation techniques for inorganic contaminants (nitrogen and sulfur-containing compounds, iron, heavy metals, metalloids and radionuclides). The course explores fundamental chemical and biological processes as well as engineering aspects.

Career: Graduate

Course typically offered:

Main Campus: Spring

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 569A: Air Pollution I: Gases (3 units)

Description: An introduction to the chemistry and physics of the troposphere and stratosphere. Topics include natural biogeochemical cycles; atmospheric photochemistry; stratospheric ozone; urban ozone and particulate matter; atmospheric visibility; acid deposition; air pollution meteorology; Gaussian plume model; photochemical model; air quality regulations. Graduate-level requirements include additional homework and other exercises.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CHEE 569A

Also offered as: ATMO 569A

Co-convened with: CHEE 469A

Course typically offered:

Main Campus: Fall

Home department: Hydrology and Atmospheric Sciences

CHEE 569B: Air Pollution II: Aerosols (3 units)

Description: An introduction to the chemistry and physics of atmospheric aerosols. Topics include aerosol sources and sinks; basic aerosol properties; single aerosol mechanics; aerosol population dynamics; atmospheric aerosol optics; aerosols and climate; aerosols and health; regional haze; aerosol measurement techniques. Graduate-level requirements include additional homework and other exercises.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CHEE 569B, CHEE 596B, SWES 569B

Also offered as: ATMO 569B, ENVS 569B

Co-convened with: CHEE 469B

Course typically offered:

Main Campus: Spring (odd years only)

Home department: Hydrology and Atmospheric Sciences

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 572: Interfacial Chemistry of Biomolecules in Environmental Systems (3 units)

Description: Taught in even years. Introduction to the chemical and adhesive properties of macromolecules at interfaces. The fundamental physico-chemical forces that govern adsorption of macromolecules at interfaces and inter-particle adhesion will be discussed. Topics such as surface tension, self-assembly, adsorption of polymers and biomolecules, and bacterial cell adhesion will be discussed with emphasis on environmental applications.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CHEE 572

Also offered as: ENVS 572

Course typically offered:

Main Campus: Spring (even years only)

Recommendations and additional information: CHEM 152 or CHEM 162 required or permission of instructor.

Home department: Soil, Water, & Environmental Sciences

CHEE 573: Biodegradation of Hazardous Organic Compounds (3 units)

Description: To learn and integrate the basic principles of microbiology required for understanding of application of bioremediation to contaminated sites. To become familiar with current research in bioremediation. To learn to solve problems often encountered in application of bioremediation.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 573

Also offered as: CE 573

Co-convened with: CHEE 473

Course typically offered:

Main Campus: Spring

CHEE 574: Fate and Transport Processes in Environmental Engineering (3 units)

Description: Processes affecting mass transfer and transformation in natural and engineered environmental systems. Process modeling using reactor models. Mass transfer kinetics and equilibrium. Mass and energy balances.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 574, CHE 574

Also offered as: CE 574

Co-convened with:

Course typically offered:

Main Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 576A: Water Treatment System Design (3 units)

Description: Application of theory and engineering experience to the design of unit operations for the production of potable water. Covers water regulations, conventional treatment technologies and selected advanced treatment topics. Graduate-level requirements include a research paper.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 576A

Also offered as: CE 576A

Co-convened with: CHEE 476A

Course typically offered:

Main Campus: Fall

CHEE 576B: Wastewater Treatment Design System (3 units)

Description: Application of theory and engineering experience to the design of unit operations for the treatment of wastewater. Covers water regulations, conventional treatment technologies and selected advanced treatment topics. Graduate-level requirements include additional homework problems, a course paper, and additional exam questions.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 576B

Also offered as: CE 576B

Co-convened with: CHEE 476B

Course typically offered:

Main Campus: Fall

CHEE 577R: Microbiology for Engineers (3 units)

Description: This course focuses on the principles of microbiology, including physiology, metabolism, genetics and ecology. The course explores fundamental microbial processes as well as their environmental significance and application in environmental engineering. A laboratory is associated with the lecture course to provide laboratory skills in basic and applied microbiology. Graduate-level requirements include oral reports. Each graduate student will receive a topic related to environmental microbiology to prepare an oral report. The report will be based on a literature search. Students will be requested to prepare a Powerpoint presentation and to summarize their findings in a 15-min oral presentation to the class.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Co-convened with: CHEE 577R

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 581B: Cell and Tissue Engineering (3 units)

Description: Development of biological engineering methods including applied genetics, metabolic regulation, and bioreactors employed in industrial processes for manufacture of pharmaceuticals and in the design of tissue engineered devices to replace normal physiological function. Graduate-level requirements include two additional design projects, homework problems requiring a greater degree of mathematics, and exams containing questions which evaluate a higher level of thought processes.

Grading basis: Regular Grades

Career: Graduate

Flat Fee: \$100

Course Components:	Laboratory	May Be Offered
	Lecture	Required

Equivalent to: BME 581B, CHEE 581B

Also offered as: BE 581B, BME 581B

Co-convened with: CHEE 481B

Course typically offered:

Main Campus: Spring

Home department: Biomedical Engineering

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 582: Analysis of Emerging Environmental Contaminants (3 units)

Description: Contaminants of emerging concern (CECs) have become major scientific and political issues. Many of these environmental contaminants have been detected in air, water, soil, and/or biota. Most CECs are identified and quantified based on non-standardized methods, often with limited or questionable quality assurance and quality control. At times, public policy and resource allocation are based on these uncertain data. Moreover, there are thousands of potential contaminants for which no analytical methodologies have yet been developed. Through this course, students will become familiar with the diversity of analytical (instrumental) and bioanalytical (bioassays) tools currently available, and will gain knowledge as to the pros and cons of each approach. The class also will discuss future opportunities, such as development of on-line sensors and miniaturization of environmental methods. While the emphasis of the course will be on water analysis, the class will also briefly discuss implications for other environmental matrices such as biosolids, sediments, solids, tissues, body fluids, and aerosols. Contaminants will be discussed in terms of classes (i.e., pharmaceuticals, steroid hormones, nanoparticles, metals, disinfection byproducts) as well as physical chemical properties (i.e., water solubility, acid/base, volatility, molecular weight, molecular geometry). This class will provide a hands-on experience with the key instrument platforms such as gas chromatography with mass spectrometric detection, inductively coupled plasma with mass spectrometric detection, liquid chromatography with diode array UV, fluorescence, and mass spectrometric detection. Instruction on select instrumental software platforms will also be demonstrated and basic integration, calibration, and data export will be discussed. Cellular and whole animal bioassays for the screening of complex mixtures of contaminants will be discussed and demonstrated. The key principals of toxicity identification and evaluation (TIE) will be covered in this class, along with real world examples of how TIE is used to determine causes of observed environmental toxicity. Students will work independently and as groups to investigate a key issue relative to environmental analysis, write a paper on this topic, and present and defend their findings before the class. Graduate-level requirements include essay questions on exams and completing a longer more involved term paper and research proposal.

Grading basis: Regular Grades

Career: Graduate

Course Components:	Lecture	Required
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Co-convened with: CHEE 482

Course typically offered:

Main Campus: Spring

-SA represents a Student Abroad & Student Exchange offering

-**CC** represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

Description: The aim of this course is to develop a working understanding of the foundations of polymeric materials. Successful completion of this course will allow you to understand basic polymer chemistry, characterization of polymers, and polymer behavior. Topics covered include the structure of polymers, mechanisms of polymer synthesis, characterization methods (including calorimetric, mechanical, rheological, and X-ray-based techniques), and their electronic, mechanical, and thermodynamic properties. Special classes of polymers: engineering plastics, semiconducting polymers, photoresists, and polymers for medicine.

Main Campus: Fall

Main Campus: Spring

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 589: Trends in Nanomedicine Engineering - Fundamentals of Therapeutics and Drug Delivery Systems (3 units)

Description: Nanomedicine engineering research involves the advance of diagnostics for rapid screening and monitoring, controlled and localized drug delivery, targeted cancer therapies, enhanced cell material interactions, scaffolds for tissue engineering, and gene delivery systems amongst others. Developments in nanomedicine engineering to effectively benefit patients require the interaction of diverse disciplines including chemistry, biochemistry, biophysics, engineering, materials science, cellular and molecular biology, pharmaceutical sciences and clinical translational medicine. This interdisciplinary course will address how materials are fabricated, characterized and interact in biological systems. The emphasis of the course will be in the application of therapeutics and controlled release drug delivery systems. Integration of biomaterial nanostructures and release analysis will be highlighted throughout the course. Through lectures, paper reviews, class discussions, experimental lab exposure, class presentations and homework assignments, students will develop an in depth understanding of the various ways nanoparticles have been used as diagnostics tools, in advancing tissue engineering and in how drug delivery systems can be improved to overcome the problems associated with typical oral and intravenous administration. Several types of drug and gene delivery methods including oral, transdermal, implantable, targeted and pulmonary will be discussed. The course will highlight the rational design of drug delivery devices based on the fundamental understanding in engineering, pharmacology, chemistry and biomaterials science. Graduate level requirements include: term paper related to research related field in the form of a research proposal.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Course typically offered:

Main Campus: Spring

CHEE 591: Preceptorship (1 - 3 units)

Description: Specialized work consisting of individual instruction and practice in chemical or environmental engineering. Activities may include instruction in laboratories and discussion sessions, and preparation and support of course materials.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 3 times.

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 594: Practicum (1 - 5 units)

Description: Practical professional training. Student will play an engineer-in-training role within a municipal agency or consulting firm. These periods of apprenticeship or training and professional activities will be arranged in an ad hoc basis to the mutual satisfaction of student's advisor and the sponsoring agency.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CHEE 597: Workshop (3 units)

Description: The practical application of theoretical learning within a small group setting and involving an exchange of ideas and practical methods, skills, and principles.

Grading basis: Regular Grades

Career: Graduate

Course Components: Workshop Required

Repeatable: Course can be repeated a maximum of 2 times.

Co-convened with: CHEE 497

Course typically offered:

Main Campus: Fall

CHEE 597A: Engineering GK-12 (1 unit)

Description: This workshop will support graduate fellows working in K-12 classrooms through the Engineering program. Through weekly discussions, reading and journaling, graduate students will reflect upon their classroom experiences, share teaching strategies and learn about the processes of teaching and learning engineering.

Grading basis: Regular Grades

Career: Graduate

Course Components: Workshop Required

Repeatable: Course can be repeated a maximum of 2 times.

Course typically offered:

Main Campus: Fall, Spring

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 597B: Engineering Outreach Methodology (1 unit)

Description: This workshop will support graduate students interested in K-12 outreach and working in K-12 classrooms through the Engineering program. Through weekly discussions, assignments, reading and journaling, graduate students will learn teaching methods and about how engineering concepts are incorporated into everyday classes.

Grading basis: Regular Grades

Career: Graduate

Course Components: Workshop Required

Course typically offered:

Main Campus: Spring

CHEE 599: Independent Study (1 - 3 units)

Description: Qualified students working on an individual basis with professors who have agreed to supervise such work. Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring

CHEE 676: Advanced Water and Wastewater Treatment (3 units)

Description: Advanced design for water and wastewater treatment. Emphasis on modern environmental engineering processes for water and wastewater treatment.

Grading basis: Regular Grades

Career: Graduate

Course Components: Lecture Required

Equivalent to: CE 676

Also offered as: CE 676

Course typically offered:

Main Campus: Fall

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 696A: Chemical Engineering (1 unit)

Description: The development and exchange of scholarly information, usually in a small group setting. The scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports, and/or papers.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Seminar Required

Repeatable: Course can be repeated a maximum of 7 times.

Course typically offered:

Main Campus: Fall, Spring

CHEE 696C: Topics in Mine Environment Management (1 - 2 units)

Description: Topics in state of the art and practice for mine reclamation and environmental management of mine sites will be discussed from current literature. Students will gain an understanding of mining operations and the environmental impacts of the mine that need to be managed. Students will integrate readings in soil science, geology, hydrology, chemistry, biology, and engineering to formulate research topics.

Grading basis: Regular Grades

Career: Graduate

Course Components: Seminar Required

Also offered as: ENVS 696C, MNE 696C, RNR 696C

Course typically offered:

Main Campus: Fall, Spring

Online Campus: Fall, Spring

Home department: Mining & Geological Engineering

CHEE 900: Research (1 - 6 units)

Description: Individual research, not related to thesis or dissertation preparation, by graduate students.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.

CHEE 909: Master's Report (1 - 4 units)

Description: Individual study or special project or formal report thereof submitted in lieu of thesis for master's degree.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Course typically offered:

Main Campus: Fall, Spring

CHEE 910: Thesis (1 - 12 units)

Description: Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department.

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

CHEE 920: Dissertation (1 - 12 units)

Description: Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing).

Grading basis: Alternative Grading: S, P, F

Career: Graduate

Course Components: Independent Study Required

Repeatable: Course can be repeated a maximum of 99 times.

Course typically offered:

Main Campus: Fall, Spring, Summer

-SA represents a Student Abroad & Student Exchange offering

-CC represents a Correspondence Course offering

May Be Offered Departments may offer this component in some semesters. See the Schedule of Classes for term-specific offerings.