Chemical Engineering

Purpose Goals

Chemical Engineering is unique in the engineering profession in that it requires a strong foundation in chemical principles, as well as in the physical and engineering sciences common to all branches of engineering. An education in Chemical Engineering is one of the broadest—the chemical engineer may find employment in all phases of technical operations. Chemical process industries supply society with a vast array of products, including chemicals, fuels, plastics, metals, foods, pharmaceuticals, textiles, and cryogenic materials. In recent years, Chemical Engineers have found employment in the microelectronics industry and in the advanced materials, biochemical, and biomedical engineering fields. Chemical Engineers also serve society by reducing and eliminating pollution.

The primary goal of the department is to prepare engineers who are well qualified to design and operate chemical processes. The goals of the department include the fostering of professional ethics, standards, and practices; the development of conceptual and analytical skills in problem-solving; and the development of the student's perception and creative faculties. More specifically, the department has the following objectives, which are to:

1. Achieve success in advanced studies, if they so choose, and pursue successful professional careers in new and emerging areas, as well as traditional chemical engineering areas;
2. Attain leadership roles in professional settings in field of choice, with high levels of competence, ethics, and safety consciousness;
3. Maintain and raise their level of engineering competence and achievement by engaging in lifelong learning.

Admission Requirements

Table 1. First-time Freshmen Requirements for Direct Admission to the Chemical Engineering Program

Academic Major	Meet PVAMU Admission Standards	High School GPA	SAT/ACT	High School Rank	THEA Passed
Chemical Engineering	Yes	3.00	New SAT: 950/18		

Table 2. Transfer Students Requirements for Direct Admission to the Chemical Engineering Program

Academic Major	Meet PVAMU Admission Standards	Transfer Grades	Transfer GPA (Math; Science and Engineering)
Chemical Engineering	Yes	"C" or greater	2.50

These tables represent a summary of admission requirements. For more detailed requirements see the section in the catalog pertaining to the Roy G. Perry College of Engineering (http://catalog.pvamu.edu/academicprogramsanddegreeplans/roygperrycollegeofengineering/#collegerequirementstext) college requirements.

Accreditation Status

The Chemical Engineering program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

Bachelor of Science in Chemical Engineering Degree Program Requirements

Complete Core Curriculum Listing at https://catalog.pvamu.edu/universitycorecurriculum/

Core Curriculum 42 Credit Hours		
Communication		6
ENGL 1301	Freshman Composition I	
ENGL 2311	Technical and Business Writing	
Mathematics		3
MATH 2413	Calculus with Analytic Geometry I	
Life & Physical Sciences		6
PHYS 2325	University Physics I	
PHYS 2326	University Physics II	
Language, Philosophy & Culture (Select One)		3
Creative Arts (Select One)		3
American History		6
HIST 1301	United States History I	
HIST 1302	United States History II	
Government/Political Science		6

POSC 2305	American Government	
POSC 2306	Texas Government	
Social & Behavioral Sciences		3
CHEG 2308	Eco Anal Technical Application	
Component Area Option One		3
CVEG 2304	Global Development Issues	
Component Area Option Two		3
COMM 1311	Introduction to Speech Communication	
College Requirements [1]		
CHEG 1101	Intro Engr, Comp Sci & Tech	1
CHEG 1102	Intro CHEG Lab	1
CHEG 2334	Chemical Engineering Thermodynamics I	3
CHEG 4247	Senior Design and Professionalism -I	2
CHEG 4248	Senior Design and Professionalism - II	2
CHEM 1112	General Chemistry Lab II	1
CHEM 1403	Chemistry for Engineers	4
OR		
CHEM 1303 & CHEM 1304	General Inorganic Chemistry I and General Inorganic Chemistry II	
CVEG 2400	Statics and Dynamics	4
ELEG 2315	Introduction to Electrical Engineering	3
MATH 2320	Differential Equations	3
MATH 2413	Calculus with Analytic Geometry I	1
MATH 2414	Calculus with Analytic Geometry II	4
MATH 3302	Probability and Statistics	3
MATH 4317	Advanced Math for Engineers	3
PHYS 2125	University Physics Lab I	1
PHYS 2126	University Physics Lab II	1
Major Requirements		
CHEG 1202	Introduction to Computations in CHEG	2
CHEG 2301	Materials Science	3
CHEG 2333	Material and Energy Balances	3
CHEG 3101	Chemical Engineering Laboratory I	1
CHEG 3301	Heat, Mass, and Momentum Transport	3
CHEG 3302	Unit Operations	3
CHEG 3304	Chemical Engineering Thermodynamics II	3
CHEG 3305	Equilibrium Stage Separation Processes	3
CHEG 3306	Chemical Reaction Kinetics and Reactor Design	3
CHEG 4101	Chemical Engineering Laboratory II	1
CHEG 4104	Chemical Engineering Laboratory III	1
CHEG 4303	Process Dynamics and Control	3
CHEG 4304	Chemical Process Design and Analysis	3
Support Area Requirements		
CHEM 2303	General Organic Chemistry I	3
CHEM 2304	General Organic Chemistry II	3
CHEM 3341	Physical Chemistry	3
Electives		**11**
Total Hours		**131**

Chemistry Electives

3-Hour Advanced Chemistry Elective (select 3 hours from the following):		3
CHEM 3342	Physical Chemistry	
CHEM 4302	Forensic Chemistry	

CHEM 4303	Biochemistry	
CHEM 4305	Instrumental Analysis	
CHEM 4306	Inorganic Chemistry	
Or Another Course Approved by the Department		
2-Hour Chemistry Lab Elective (select from the following):		2
CHEG 2215	Biochemical Engineering Fundamentals Lab	
CHEM 2201	Quantitative Analysis	
CHEM 2203	Organic Chemistry Lab I	
CHEM 2204	Organic Chemistry Lab II	
CHEM 2211	Quantitative Analysis Lab	
CHEM 3242	Physical Chemistry Lab	
CHEM 3243	Physical Chemistry Lab	
CHEM 4203	Forensic Chemistry Lab	
CHEM 4204	Biochemistry Laboratory	
CHEM 4205	Instrumental Analysis Lab	
Technical Electives [2]		6
CHEG 3311	Introduction to Energy Systems	
CHEG 3312	Petroleum Engineering Fundamentals	
CHEG 3315	Introduction to Biotechnology	
CHEG 4310	Special Topics in Chemical Engineering	
CHEG 4312	Process Safety Engineering Fundamentals	
CHEG 4313	Process Modeling and Simulation	
CHEG 4315	Bioengineering	
CHEG 4318	Design of Process Engineering Systems	
CHEG 4321	Nuclear Science Fundamentals	
CHEG 4322	Nuclear Forensic Analysis	
MCEG 4309	Finite Element Analysis and Design	
ELEG 3303	Physical Principles of Solid State Devices	
Total Hours		**11**

Bioengineering Concentration [3]		
CHEM 4303	Biochemistry	3
CHEM 4204	Biochemistry Laboratory	2
Technical Electives		**6**
CHEG 3315	Introduction to Biotechnology	
CHEG 4315	Bioengineering	
CHEG 4310	Special Topics in Chemical Engineering	
Total Hours		**11**

1 Students must see their advisor to discuss prerequisites to major course requirements.

2 Technical electives must be 3000 level or higher. All 6 hours must be in engineering. Internship and co-op courses are not suitable as technical electives.

3 All students in the Bioengineering concentration must complete a project that is Bioengineering related.

Technical Electives through Five-Year BS/MS Degree Plan Option

Students may, upon approval to the Five-Year BS/MS Degree Plan Option (see Roy G. Perry College of Engineering Other Programs section), apply up to six semester credit hours of graduate courses toward technical electives requirements.

Eligibility to Take Upper Division College Courses

The Roy G. Perry College of Engineering requires an eligibility standard for the students to take upper-division college courses. Students must have completed or be currently enrolled in all lower division (1000 and 2000 level) courses in English, Mathematics, Science, and Engineering to be eligible to enroll in upper-division (3000 or 4000 levels) courses in the Roy G. Perry College of Engineering. Students in the Chemical Engineering Program must complete a prescribed list of courses in the following with a minimum Grade Point Average (GPA) of 2.5 to be eligible to enroll in upper-division (3000 or 4000 levels) courses in the College. Students transferring to the Roy G. Perry College of Engineering with 60 or more semester hours from another

institution will be allowed a period of one semester to comply. The following is a list of courses that must be completed prior to enrolling in upper-division courses.

ENGL 2311	Technical and Business Writing	3
CHEM 1112	General Chemistry Lab II	1
CHEM 1403	Chemistry for Engineers	4
MATH 2413	Calculus with Analytic Geometry I	4
MATH 2414	Calculus with Analytic Geometry II	4
PHYS 2125	University Physics Lab I	1
PHYS 2325	University Physics I	3
CHEG 1202	Introduction to Computations in CHEG	2
CHEG 1101	Intro Engr, Comp Sci & Tech	1
CHEG 1102	Intro CHEG Lab	1

Chemical Engineering as a Minor Field

Requirements for Chemical Engineering as a Minor Field

Students must complete 30 semester credit hours as listed below to satisfy the requirements for a minor in the discipline of chemical engineering.

CHEG 2301	Materials Science	3
CHEG 3301	Heat, Mass, and Momentum Transport [1]	3
CHEG 2333	Material and Energy Balances	3
CHEG 2334	Chemical Engineering Thermodynamics I	3
CHEG 3302	Unit Operations	3
CHEG 3305	Equilibrium Stage Separation Processes [1]	3
CHEG 3304	Chemical Engineering Thermodynamics II [1]	3
CHEG 3306	Chemical Reaction Kinetics and Reactor Design [1]	3
CHEG 4304	Chemical Process Design and Analysis [1]	3
Technical Elective (Any CHEG 3000 or 4000 level)		3
Total Hours		**30**

[1] Indicates course requirements not eligible to be met with courses used to meet major requirements.

Professional and Honor Societies

Student organizations play an important role in helping students to adjust to the responsibilities of their profession and in recognizing high academic achievement. Students are encouraged to become active members of the organizations sponsored by the department. The department sponsors the following organizations:

American Institute of Chemical Engineers (A.I.Ch.E.) - Student Chapter. This chapter is a part of the national American Institute of Chemical Engineers organization, which is the premier professional society for chemical engineers nationwide. AIChE is the life-long home of chemical engineers nationwide. The student chapter promotes professionalism, professional development, and service to society.

Iota Beta Chapter of Omega Chi Epsilon . This is a chapter of the National Honorary Society Omega Chi Epsilon. The objectives of this organization are to promote and recognize chemical engineering academic excellence, graduate research, professionalism, sociability, character, and leadership among the chemical engineering students.

American Chemical Society (A.C.S.) - Student Chapter. This chapter is a part of the national professional society for chemists and chemical engineers, and is sponsored in cooperation with the Department of Chemistry.

American Nuclear Society PV Chapter (ANS-PV) – Student Chapter. The objectives of this organization are to promote the diverse field of nuclear science and technology, increase awareness and understanding of its diverse application in modern engineering, and to introduce students to the emergent career opportunities in nuclear engineering nationally and internationally. The student chapter is supported by the nuclear engineering program within chemical engineering department. Membership is open to all who are motivated to be enlightened in the growing field of the nuclear science and technology.

Society of Petroleum Engineers (S.P.E.) - Student Chapter. This chapter is a part of the national Society of Petroleum Engineers organization. The SPE is an international technical/professional organization dedicated to the advancement of technology associated with oil and gas exploration, production,

refining, and processing. Student membership provides students the opportunity to meet practicing professionals and active members in the industry while still attending school.

National Organization of Black Chemists and Chemical Engineers (N.O.B.C.Ch.E) - Student Chapter. This chapter is part of the national NOBCChE organization. Its goals are to promote professionalism and advance technical careers for African Americans, with chemistry and chemical engineers as a particular focus. Membership is open to all who share these objectives. This chapter is co-sponsored with the Department of Chemistry.

Students of chemical engineering are also eligible for membership in the other professional and honor societies of the college and the university.

BSCHE Chemical Engineering

Core: https://catalog.pvamu.edu/universitycorecurriculum/

Freshman

Fall - Semester 1	Hours	Spring - Semester 2	Hours	Summer	Hours
Mathematics Core	4	MATH 2414	4	Government/Political Science Core	3
MATH 2413		CHEG 1202	2	POSC 2305	
CHEG 1101	1	CHEM 1403	4		
CHEG 1102	1	CHEM 1112	1		
COMM 1311	3	Life and Physical Sciences Core	3		
Component Area Option Two Core	3	PHYS 2325			
Communication Core	3	PHYS 2125	1		
ENGL 1301		Communication Core	3		
American History Core		ENGL 2311			
HIST 1301					
Total	**15**	**Total**	**18**	**Total**	**3**

Total Hours: 36

Sophomore

Fall - Semester 1	Hours	Spring - Semester 2	Hours
CHEG 2301	3	CHEM 2304	3
CHEG 2333	3	Component Area Option One Core	3
CHEM 2303	3	CVEG 2304	
Life and Physical Sciences Core	3	CHEG 2334	3
PHYS 2326		ELEG 2315	3
PHYS 2126	1	CVEG 2400	4
MATH 2320	3		
Total	**16**	**Total**	**16**

Total Hours: 32

Junior

Fall - Semester 1	Hours	Spring - Semester 2	Hours
CHEM 3341	3	MATH 4317	3
CHEG 3301	3	CHEG 3101	1
CHEG 3302	3	CHEG 3305	3
CHEG 3304	3	CHEG 3306	3
Social and Behavioral Science Core	3	Restricted Elective	3
CHEG 2308		Restricted Elective	2
MATH 3302	3		
Total	**18**	**Total**	**15**

Total Hours: 33

Senior			
Fall - Semester 1	**Hours**	**Spring - Semester 2**	**Hours**
CHEG 4101	1	CHEG 4104	1
CHEG 4303	3	Restricted Elective	3
CHEG 4304	3	CHEG 4248	2
CHEG 4247	2	Language, Philosophy, and Culture Core	3
Restricted Elective	3	Creative Arts Core	3
American History Core	3	Government/Political Science Core	3
HIST 1302		POSC 2306	
Total	**15**	**Total**	**15**

Total Hours: 30

Total Semester Credit Hours: 131

Marketable Skills

Marketable skills, as defined by the Texas Higher Education Coordinating Board's 60x30TX Plan (http://www.60x30tx.com/), include interpersonal, cognitive, and applied skill areas, are valued by employers, and can be either primary or complementary to a major. Marketable skills are acquired by students through education, including curricular, co-curricular, and extracurricular activities.

BSCHE Chemical Engineering

Degree Skills

1. Strong interpersonal, oral, and written communication skills and the ability to communicate effectively with project team members
2. Strong analytical and problem-solving skills including the use of spreadsheets and computer simulation software in design
3. Maintain and raise their level of engineering competence and achievement by engaging in lifelong learning

Concentration Skills

1. Ability to collaborate and work effectively in a variety of teams, including multi-disciplinary teams
2. Attain leadership roles in professional settings with high levels of competence, ethics and safety consciousness
3. Successfully pursue advanced studies and/or professional careers in new and emerging areas, as well as traditional chemical engineering

Courses

CHEG 1101 Intro Engr, Comp Sci & Tech: 1 semester hour.
Introduction to basic engineering, computer science and technology concepts. Students will become aware of the various disciplines of engineering, computer science and technology, ethical and professional responsibilities in these fields, creativity and design.
Co-requisites: CHEG 1102, GNEG 1010.

CHEG 1102 Intro CHEG Lab: 1 semester hour.
Introduction to the field of engineering, industries, careers, and the curriculum. Basic engineering terms, concepts, calculations problem solving skills, ethics, and computer applications.
Co-requisite: CHEG 1101.

CHEG 1202 Introduction to Computations in CHEG: 2 semester hours.
An introductory course of important chemical engineering concepts and computations. Students will learn how to classify problems based on their mathematical nature. Topics include basic introductory calculations involving material and energy balances, fluid flow phenomena, fundamental thermodynamics and kinetics, and introductory software and simulation tools such as Visual Basic and CHEMCAD.
Prerequisites: CHEG 1102 or CHEG 1021.
Co-requisite: MATH 2413.

CHEG 2215 Biochemical Engineering Fundamentals Lab: 2 semester hours.
This course consists of biochemical engineering laboratory experiments, with emphasis on biochemical reactors, mass transfer in bioreactors, microbial transformations and enzyme catalyzed reactions and their control. Measurement of maximum specific growth rate, saturation constants of substrates, kinetic constants of enzymes and characterization of immobilized enzymes will be carried out. Analysis oxygen absorption rates in shake-flasks in the study of control of respiration and fermentation in baker's yeast, kinetics of yeast growth, kinetics of free and immobilized enzyme reactions and operational decay constant and half-life of immobilized enzymes.

CHEG 2301 Materials Science: 3 semester hours.
Chemical bonding, atomic order and disorder, transport properties, single phase and multiphase materials, heat treatment, corrosion, and composites.
Prerequisites: (CHEM 1304 or CHEM 1043) or (CHEM 1403 or CHEM 1034).

CHEG 2308 Eco Anal Technical Application: 3 semester hours.
Fundamental concepts of economic principles. Evaluation of technical alternatives, economic significance of technical proposals; interest, description, analysis, and forecasting.
Prerequisites: MATH 2413 or MATH 1124.

CHEG 2315 Introduction to Biochemical Engineering Fundamentals: 3 semester hours.
This course introduce biology fundamentals and associated subjects required for engineers to understand and design multidisciplinary technology in the complementary areas of biological sciences and engineering. to accommodate those who do not have the biological background, the course covers basic biological principles and physiology. Subsequently, special emphasis is placed on applying engineering concepts to biological problems.
Prerequisites: CHEM 1304 or CHEM 1403.

CHEG 2316 Ethical Engineering in a Global Society: 3 semester hours.
An introductory view into how moral principles and standards are applied to the field of engineering. Students will learn how to navigate ethical problems. Topics include the responsibilities of an engineer, the code of conduct, ethical theories, ethics in the law, and case studies of engineering successes and failures.
Prerequisites: (CHEG 1101 or CHEG 1011) or (CVEG 1101 or CVEG 1011) or (ELEG 1101 or ELEG 1011) or (MCEG 1101 or MCEG 1011).

CHEG 2333 Material and Energy Balances: 3 semester hours.
Application of laws of conservation of mass and energy to reacting and non-reacting, simple and complex chemical systems. Application of both element and species balances to multiple reaction systems. Application of the degrees-of-freedom analysis to single process units and multi-unit process flow-sheets. Numerical solution techniques for the solution of balance equations.
Prerequisites: (CHEM 1403 or CHEM 1034) and (PHYS 2325 or PHYS 2513).

CHEG 2334 Chemical Engineering Thermodynamics I: 3 semester hours.
Introduction to chemical engineering calculations. PVT properties of fluids, equations of state. First and second laws of thermodynamics. Applications to heat effects and flow processes.
Prerequisites: CHEG 2333 or CHEG 2053.

CHEG 2615 Chemical Engineering Internship I: 6 semester hours.
This course is an internship program of work experience with an approved engineering firm.

CHEG 3101 Chemical Engineering Laboratory I: 1 semester hour.
Quantitative experimental study of properties of fluids, fluid mechanics, metering, and heat transfer. Operation and evaluation of equipment, techniques of graphical and statistical data analysis. Study of elements and methods of scientific inquiry and investigation, experimental data analysis, modeling and simulation, and dissemination of scientific results, including: design of experiments, product and process design, model validation and verification, literature survey and review techniques, and effective technical reporting modes. Strong emphasis is placed on safety.
Prerequisites: PHYS 2125 or PHYS 2511 and (PHYS 2126 or PHYS 2521) and (CHEM 1112 or CHEM 1021) and (COMM 1311 or COMM 1003) and (ENGL 1302 or ENGL 1133 or ENGL 1143 or ENGL 2311).
Co-requisites: CHEG 3301, CHEG 3304, MATH 3302.

CHEG 3301 Heat, Mass, and Momentum Transport: 3 semester hours.
Macroscopic and differential balances for heat, mass, and momentum. Energy balances and mechanical energy balances. Ideal Newtonian and non-Newtonian fluid behavior. Comparison of the transport processes in laminar and turbulent flow. Dimensional analysis.
Prerequisites: (CHEG 2334 or CHEG 2043) and (MATH 2320 or MATH 2043).

CHEG 3302 Unit Operations: 3 semester hours.
Application of transport theory to the design of equipment for the pumping and transfer of fluids through pipes, heat exchange, interphase transfer of heat and mass for the separation and purification of process streams.
Prerequisites: CHEG 2333 or (CHEG 2053 or CHEG 2305).

CHEG 3304 Chemical Engineering Thermodynamics II: 3 semester hours.
Properties of ideal and non-ideal binary and multi-component mixtures. Study of phase equilibria for single- and multi-component systems based on methods of corresponding states, equation of states and activity coefficient. Chemical equilibria applied to both homogeneous and heterogeneous systems.
Prerequisites: (CHEG 2043 or CHEG 2334).

CHEG 3305 Equilibrium Stage Separation Processes: 3 semester hours.
Applications of heat and mass balances and phase equilibria to the design of staged separation processes. Use of graphical methods such as McCabe Thiele and Ponchon Savarit for the treatment of binary systems. Application to distillation, absorption, stripping, and extraction.
Prerequisites: CHEG 2333 or CHEG 2053 and (CHEG 3304 or CHEG 3053).

CHEG 3306 Chemical Reaction Kinetics and Reactor Design: 3 semester hours.
Application of fundamental concepts of reaction stoichiometry, chemical and biochemical kinetics, and equilibria to the interpretation of reaction rate data. Application of reaction rate and heat and mass transfer correlations to the design of batch reactors, continuous staged reactors, and tubular reactors.
Prerequisites: MATH 2320 or MATH 2043 and (CHEG 3304 or CHEG 3053) and (CHEG 2301 or CHEG 2013).

CHEG 3311 Introduction to Energy Systems: 3 semester hours.
This course introduces fundamental physical and engineering principles associated with various energy systems. Basic energy concepts will be introduced describing the magnitudes and patterns of human energy needs. Historical evolution and present status of the conventional fossil and nuclear-fueled energy will be investigated along with others such as hydropower, biofuels, and the developing renewable energy systems.
Prerequisites: (MATH 2414 or MATH 2024) and (PHYS 2326 or PHYS 2523) and ((CHEM 1403 or CHEM 1034) or (CHEM 1304 or CHEM 1043)).

CHEG 3312 Petroleum Engineering Fundamentals: 3 semester hours.
This course consists of an overview of petroleum industry and petroleum engineering including nature of oil and gas reservoirs, petroleum exploration and drilling, formation evaluation, well completions and production, surface facilities, reservoir mechanics, and improved oil recovery.

CHEG 3315 Introduction to Biotechnology: 3 semester hours.
This course introduces students of chemical engineering, biological sciences, and chemistry to biological concepts and Nano scale considerations in engineering applications. It provides training for effective communication, hands-on skills, and analytical tools needed to pursue careers in biological/biochemical, and biopharmaceutical process industries. Ties to relevant current research will be explored.
Prerequisites: CHEM 1304 or CHEM 1043 or CHEM 1403 or CHEM 1034 and (CHEM 2303 or CHEM 2033).

CHEG 3615 Chemical Engineering Internship II: 6 semester hours.
This course is an internship program of work experience with an approved engineering firm.

CHEG 4101 Chemical Engineering Laboratory II: 1 semester hour.
Chemical engineering laboratory directed to separation processes such as gas absorption, fractional distillation, extraction, and drying. Study of reaction rates and equilibria in simple chemical systems. Emphasis is placed upon experimental data required for the scale-up to commercial scale equipment.
Prerequisites: (CHEG 3302 or CHEG 3023) and (CHEG 3304 or CHEG 3053) and (COMM 1311 or COMM 1003 and (ENGL 1302 or ENGL 1133) or ENGL 2311 or ENGL 1143) and (PHYS 2125 or PHYS 2511) and (PHYS 2126 or PHYS 2521) and (CHEM 1112 or CHEM 1021).

CHEG 4104 Chemical Engineering Laboratory III: 1 semester hour.
Chemical engineering laboratory with emphasis on reactive and control systems. Measurement of reaction conversion, determination of reaction order and rate in a tubular reactor. Analysis of the dynamic responses of stirred tanks in series. Experimental study of the use of analog and digital controller for heat exchanger and flow and level control systems.
Prerequisites: CHEG 4303 or CHEG 4033 and (COMM 1311 or COMM 1003 or SPCH 1003) and (ENGL 1302 or ENGL 1133 or ENGL 1143 or ENGL 2311) and (PHYS 2125 or PHYS 2511) and (PHYS 2126 or PHYS 2521) and (CHEM 1112 or CHEM 1021).

CHEG 4247 Senior Design and Professionalism -I: 2 semester hours.
This is the first course of a two-semester capstone experience (CHEG 4248 must immediately follow 4247 or sequence must restart with 4247) involving engineering design of an industrial or advanced team project. Elements of ethics and professionalism in engineering practice are integrated into the project experience. The project will include application of relevant engineering codes and standards, as well as realistic constraints. Design achievements are demonstrated with written reports, and oral presentation, and professional standards and ethics examinations.
Prerequisites: (CHEG 3301 or CHEG 3013) and (CHEG 3023 or CHEG 3302) and (CHEG 3043 or CHEG 3305) and (CHEG 3063 or CHEG 3306).

CHEG 4248 Senior Design and Professionalism - II: 2 semester hours.
A continuation of CHEG 4247 with required design modifications of the team projects necessary to produce a working prototype of the designs initiated in Senior Design and Professionalism I. Design project deliverables include an oral presentation, as well as a final written report. Professionalism education will, and a formal demonstration of prototype, or model, of the design. Elements of professionalism reinforce the importance of professional engineering ethics, corporate culture, life-long learning, and globalization.
Prerequisites: CHEG 4247 or CHEG 4472.

CHEG 4303 Process Dynamics and Control: 3 semester hours.
Dynamic response and control of chemical process equipment such as reactors, heat exchangers, distillation columns. Use is made of fundamental techniques of servomechanism theory such as block diagrams, transfer functions, and frequency response; stability analysis and control loop design. Unsteady state modeling and computer simulation of simple control systems.
Prerequisites: (CHEG 3306 or CHEG 3063) and (MATH 4317 or MATH 4173).

CHEG 4304 Chemical Process Design and Analysis: 3 semester hours.
Use of material and energy balance calculations, thermodynamics, transfer operations, reaction kinetics and process economics for the synthesis and analysis of chemical processing systems. Design alternatives are analyzed by the use of case studies, computerized flow sheet modeling and simulation, and optimization methods. Safety and design codes are emphasized.
Prerequisites: (CHEG 3301 or CHEG 3013) and (CHEG 3302 or CHEG 3023) and (CHEG 3305 or CHEG 3043) and (CHEG 3306 or CHEG 3063).

CHEG 4310 Special Topics in Chemical Engineering: 3 semester hours.
This course presents selected current and emerging topics in chemical engineering depending on need as determined by the department faculty.

CHEG 4312 Process Safety Engineering Fundamentals: 3 semester hours.
This course addresses aspects of chemical process safety and loss prevention, such as identification of potential hazards and hazardous conditions associated with processes and equipment involved in the chemical process industries. It includes methods of predicting the severity of the associated hazards and preventing, controlling or mitigating them. It emphasizes quantitative engineering analysis; techniques for performing process hazard analysis, risk assessment, and accident investigation are introduced.

CHEG 4313 Process Modeling and Simulation: 3 semester hours.
Construction and solution of mathematical models of process units and integrated systems for computer simulation. Both steady and dynamic models will be developed. Students will make use of one or more of the commercial flow sheet simulation programs for the analysis of specific systems.

CHEG 4315 Bioengineering: 3 semester hours.
Design and analysis of biochemical systems with applications in biomedical engineering and metabolic processes, enzyme catalyzed reactions and product separation, biomass production, and wastewater treatment. Emphasis is placed upon the application of biochemical systems structure, reaction kinetics, transport processes, and control in the design and use of biochemical reactors and separation units.

CHEG 4318 Design of Process Engineering Systems: 3 semester hours.
The course will stress the interdisciplinary nature of systems design and will include structural, hydraulic, process, utilities and control concepts. Development of one or more selected applications in optimal design of continuous and batch systems. Studies will involve the use of computer-aided design, cost estimation, engineering data bases, and project scheduling.
Prerequisites: CHEG 3301 or CHEG 3013 and (CHEG 3302 or CHEG 3023) and (CHEG 3304 or CHEG 3053) and (CHEG 3306 or CHEG 3063).

CHEG 4321 Nuclear Science Fundamentals: 3 semester hours.
An interdisciplinary survey course introducing the basics of atomic and nuclear science, radiation physics and their relation to engineering problems and applications. Specific applications to nuclear materials, nuclear safety, nuclear forensics, radiation detection, radiation safety, and radiation effects on humans and technology. Technical background assumed is the standard physics, mathematics and chemistry required for an undergraduate engineering degree.

CHEG 4322 Nuclear Forensic Analysis: 3 semester hours.
The course introduces methods important to the investigation of nuclear materials to identify the source, trafficking mode, and level of enrichment of particular nuclear materials recovered from various sources such as dust at a nuclear facility locale, or post-nuclear explosion debris. Topics include radiochemistry review, nuclear applications for power and defense, contemporary issues in forensics and proliferation, methods for forensics analysis, and case studies.

CHEG 4399 Independent Study: 1-3 semester hour.
Readings, research and/or field work on selected topics. This course is intended as a curriculum supplement for highly motivated students with special areas of interest. An individualized course of study, planned by student and advisor, is executed under the direction of the advisor.

CHEG 5301 Advanced Reaction Engineering: 3 semester hours.
Rates and mechanisms of chemical reactions. Thermo and catalytic reactions both homogeneous and heterogeneous with applications. Applications to design of new materials.

CHEG 5302 Microelectronics Materials: 3 semester hours.
Heterogeneous chemical reactions. Chemical engineering aspects of materials fabrication and processing. CVD thin film deposition techniques. Preparation of superconducting powders. Composites. Modeling and practical applications.

CHEG 5303 Environmental Processes: 3 semester hours.
Fundamentals of environmental engineering, chemistry, physical-chemistry and transport properties. Energy and mass balances. Reactions and reactors. Biological processes. Bioremediation.

CHEG 5304 Remediation Technologies: 3 semester hours.
Fundamentals of environmental remediation. Physical-chemical processes. Bioremediation. Stabilization and solidification. Thermal methods. Site characterization. Risk assessment. Containment. Remedial Alternatives Applications to real contaminated sites.

CHEG 5305 Chemical Engineering Thermodynamics: 3 semester hours.
This is a survey course starting with a review of thermodynamic laws then proceeding to examine ways that thermodynamics apply to various systems from static to dynamic, inert to reactive, and ultimately from abiotic to living systems. The approach will be to engage in readings (articles, book chapters, media releases), viewings (lectures, photos, videos), discussion (face to face and web assisted), and project based design and evaluation activities.

CHEG 5306 Transport Phenomena: 3 semester hours.
Transport Phenomena provides a unified treatment of momentum, mass, and energy transport in chemical engineering problems. Vector and tensor notations and mathematics will be used in expressing equations of continuity, motion, energy. Further develops the foundations of transport phenomena to apply this knowledge to the solution of problems of interest to the engineer.

CHEG 5311 Petroleum Engineering: 3 semester hours.
This course examines the petroleum industry and petroleum engineering including nature of oil and gas reservoirs, petroleum exploration and drilling, formation evaluation, well completions and production, surface facilities, reservoir mechanics, and improved oil recovery.

CHEG 5312 Process Safety Engineering: 3 semester hours.
This course addresses multiple aspects of chemical process safety and loss prevention in chemical manufacturing. Includes methods of predicting severity of hazards and preventing/controlling/mitigating them. Emphasizes quantitative engineering analysis based on applications of engineering principles.

CHEG 5321 Nuclear Science: 3 semester hours.
The objective of this course is to explore the fundamental aspects of nuclear and radiochemistry, with emphasis on the determination of radioactive species and the application of nuclear processes, radioactive materials, and radiochemical techniques in major applications such as medicine, nuclear power, national defense, and threat reduction.

CHEG 5322 Nuclear Forensics: 3 semester hours.
This course develops nuclear forensic skills needed for potential future terrorist attempted or actual events. Students learn to answer the questions where did the nuclear material come from (attribution), what routed did it follow to the interdiction site (route attribution), what route did it follow to the interdiction site (route attribution), how to safely collect nuclear materials for an interdiction site, how nuclear materials (pre-detonation and post-detonation) are analyzed, how to evaluate of pre-detonation nuclear materials' capabilities and how to interface with emergency response, law enforcement (FBI, UHP), Intelligence community, State Department and International Treaties.