Department of Chemical and Petroleum Engineering

Chairperson: Ahmad, Mohammad
Professor: Ahmad, Mohamad
Assistant Professors: Al-Hindi, Mahmoud; Azizi, Fouad; Boyadjian, Cassia; Saad, Walid; Zeaiter, Joseph
Visiting Assistant Professors: Salameh, Youssef; Tehrani, Ali
Instructors: Itani, Adnan; El Helou, Ingrid; Mansour, Fatima

General Information

The Chemical Engineering Program offers two graduate master's programs, one leading to the degree of Master of Engineering with a major in Chemical Engineering, and one leading to the degree of Master of Science with a major in Chemical Engineering. The objectives of these programs is to provide students with:

- the skills and knowledge required to enter or enhance a career in chemical engineering.
- a significant research experience.

Master of Engineering (ME); Major: Chemical Engineering

The Chemical Engineering Program fosters a community of scholars, among its faculty members and graduate students, with an interest in advancing knowledge and contributing to the profession.

The ME program will be open to students with a Bachelor of Engineering (BE) in Chemical Engineering or other related disciplines.

The student must complete a minimum of 21 course credit hours and a 9 credit hours thesis (30 credits in total), accomplished on a full or part-time basis as below. A minimum of one calendar year of residence is required for graduation from this program.

The required 30 course credit hours and thesis are distributed as follows:

A mandatory 3-credit course in applied mathematics:
The math course or math-oriented course offered by other departments must be approved by the graduate student advisor; acceptable courses include, but are not limited to the following:

- **MATH 350** Discrete Models for Differential Equations (3 cr.)
- **MATH 351** Optimization and Nonlinear Problems (3 cr.)
- **ENMG 604** Deterministic Optimization Models (3 cr.)
- **MECH 630** Finite Element Methods in Mechanical Engineering (3 cr.)
- **MECH 663** Computational Fluid Dynamics (3 cr.)
At least two advanced fundamental chemical engineering three-credit courses from two different concentrations: (Students cannot receive credits for undergraduate courses taken during their BE in Chemical Engineering). The following is a list of recommended courses by concentration:

- **Reaction Engineering**: CHEN 617, CHEN 620
- **Transport Phenomena**: CHEN 611, CHEN 613, CHEN 615
- **Process Engineering**: CHEN 570, CHEN 571, CHEN 651
- **Seminar Course**: CHEN 797 (0 credit hours). Students must register for the course once per year.
- **Thesis**: CHEN 799 (equivalent to 9 credit hours) based on independent research

### A mandatory 6 credits of courses from Chemical Engineering Electives:

<table>
<thead>
<tr>
<th>Course</th>
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### A mandatory 6 course credit hours from Non-Chemical Engineering Electives

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### Master of Science (MS); Major: Chemical Engineering

The Chemical Engineering Program fosters a community of scholars, among its faculty members and graduate students, with an interest in advancing knowledge and contributing to the profession.

The MS program will be open to students with a Bachelor of Science (BS) in Chemical Engineering or other related disciplines.
The MS program will also be open to students with a Bachelor of Science degree in chemistry, biology, mathematics, or physics.

The student must complete a minimum of 31 course credit hours and a 9 credit hours thesis (40 credits in total), accomplished on a full or part-time basis as below. A minimum of one calendar year of residence is required for graduation from this program.

The required 40 course credit hours and thesis are distributed as follows:

### A mandatory 3-credit course in applied mathematics:

The math course or math-oriented course offered by other departments must be approved by the graduate student advisor; acceptable courses include, but are not limited to the following:

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- **Reaction Engineering:** CHEN 617, CHEN 620
- **Transport Phenomena:** CHEN 611, CHEN 613, CHEN 615
- **Process Engineering:** CHEN 570, CHEN 571, CHEN 651
- **Seminar Course:** CHEN 797 (0 credit hours). Students must register for the course once per year.
- **Thesis:** CHEN 799 (equivalent to 9 credit hours) based on independent research

### A mandatory 9 course credit hours from Chemical Engineering Electives:

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A mandatory 9 course credit hours from Non-Chemical Engineering Electives:

- CIVE 555  Air Quality Management (3 cr.)
- CIVE 552  Waste Management and Treatment (3 cr.)
- CIVE 651  Processes in Water and Wastewater Treatment (3 cr.)
- MECH 701  Principles of Combustion (3 cr.)
- MECH 760  Advanced Fluid Mechanics (3 cr.)
- MECH 761  Convection Heat Transfer (3 cr.)

Science majors wishing to pursue an MS degree in Chemical Engineering (added):

Required core chemical engineering courses: CHEN 311, CHEN 314, CHEN 411, CHEN 417, and CHEN 312.

Additionally, one of the following three courses will be required: CHEN 451, CHEN 351, CHEN 470.

Course Descriptions

CHEN 611  Transport Phenomena  3 cr.
This course covers the application of the principles of momentum, heat, and mass transfer to steady state and transient problems; molecular concepts; transport in turbulent flow; boundary layer theory; and numerical applications. Prerequisite: CHEN 411.

CHEN 620  Kinetics and Reactor Design II  3 cr.
This course covers reaction kinetics, heterogeneous catalytic reactions, transport processes with fluid-solid heterogeneous reactions, noncatalytic gas-solid reactions, catalyst deactivation, and gas-liquid reactions. Prerequisite: CHEN 417.

CHEN 531  Principles of Corrosion  3 cr.
This course includes the application of electrochemical principles, corrosion reactions, passivation, cathodic and anodic protection, stress corrosion, and high-temperature oxidation. Prerequisites: CHEN 314 and MECH 340.

CHEN 570  Process Synthesis and Optimization  3 cr.
An introduction to the design and synthesis for the large scale production and processing of materials such as water, chemicals, petroleum products, food, drugs, and waste. The course introduces principles of optimization: continuous, linear and nonlinear, and mixed-integer linear and nonlinear problems. Applications will address heat exchanger network synthesis, energy system designs, distillation and separation system selection, and optimization and design under uncertainty. Prerequisites: CHEN 411, CHEN 451, and CHEN 470.

CHEN 571  Chemical Product Design  3 cr.
This course covers the application of the design process of products based on chemical technology. It covers the entire design process from initial identification of product needs to the
generation and selection of product ideas and culminates in the manufacture of a new product. 

Prerequisites: CHEN 411 and CHEN 470.

**CHEN 590 Petroleum Refining 3 cr.**
General review of refining processes of crude oil; Shortcut methods for practical design calculations; Design of atmospheric, vacuum, and pressure columns for petroleum fractionation, including auxiliary furnaces and condensers; Recent developments in heavy oil processing. **Prerequisite: CHEN 312.**

**CHEN 612 Desalination 3 cr.**
A course that will provide an in depth coverage of the commonly used thermal and membrane based desalination technologies. Fundamental thermodynamic and transport processes which govern desalination will be developed. Environmental, sustainability and economic factors which may influence the performance, affordability and more wide-spread use of desalination systems for fresh water production and reuse will be highlighted. Renewable energy technologies coupled with desalination processes will be reviewed. A team based student project will be assigned to design a reverse osmosis membrane desalination plant (brackish water, seawater, or treated sewage effluent) using conventional or alternative energy sources. **Prerequisite: CHEN 411 or MECH 412.**

**CHEN 613 Membrane Separation Processes 3cr.**
The course will provide a general introduction to membrane science and technology: transport mechanisms, membrane preparation and boundary layer effects. The course will also cover the various types of membranes used in industry: microfiltration, ultrafiltration, reverse osmosis, electro-dialysis and pervaporation. **Prerequisites: CHEN 312 and CHEN 411.**

**CHEN 615 Advanced Mass Transfer Processes 3 cr.**
This course will cover a review of molecular and turbulent diffusion and mass transfer coefficients, mass transfer equipment design including absorption and cooling towers, adsorption and ion exchange. **Prerequisite: CHEN 411.**

**CHEN 617 Chemical Reactor Analysis and Design 3 cr.**
This course covers design for optimum selectivity; stability and transient behavior of the mixed flow reactor; non-ideal flow and balance models; fixed and fluidized bed reactors; and multiphase flow reactors. **Prerequisite: CHEN 417.**

**CHEN 618 Colloid and Interface Science 3 cr.**
This is a first course in colloid and interface science. The repulsive and attractive forces at interfaces are described along with the dynamics of the interfaces. Topics include the stability of macroemulsions, the formulation and properties of microemulsions, and surface metal-support interactions of catalysts. **Prerequisite: CHEN 314.**

**CHEN 651 Advanced Process Control 3cr.**
This course covers the mathematical modeling and computer simulation of process dynamics and control. **Prerequisite: CHEN 451.**

**CHEN 670 Advanced Process Flow-Sheeting 3 cr.**
This course highlights the engineering tools used during the life-cycle of chemical plants from the Front-End and Engineering Design (FEED) stage to operation. Flow-sheeting tools will be
used for analysis, dynamic modeling for startup-shutdown and control dynamics, and plant-wide optimization for plant performance improvement. **Prerequisite:** CHEN 570.

**CHEN 672**  
**Polymer Science**  
3 cr.  
This course is a broad technical overview of the nature of synthetic macromolecules, including the formation of polymers and their structure, structure-property relationships, polymer characterization and processing, and applications of polymers. The course tends to focus on thermoplastic polymers and elastomers. **Prerequisite:** MECH 340.

**CHEN 673**  
**Engineering of Drug Delivery Systems**  
3 cr.  
This course focuses on recent advances in the development of novel drug delivery systems. The fundamentals of drug delivery are discussed. Various strategies to tune and control the release of active agents for optimized therapeutic outcomes are explored. The course covers polymers and techniques used to produce drug nanoparticles, with specific examples of nanoparticle-based drug delivery systems. **Prerequisites:** CHEN 314 and CHEN 411.

**CHEN 674**  
**Process Operations and Diagnosis**  
3 cr.  
This course covers troubleshooting, fault detection, and diagnostics in key chemical processes. Statistical tools such as Principle Component Analysis, Fisher Discriminant Analysis, Partial Least Squares and Canonical Variate Analysis methods are studied. Analytical and knowledge based approaches are also covered. Processes and case studies include: gas-oil separation (GOSP), natural gas processing (AGR, NGL, SRU, fractionation, amine scrubbing), crude oil refining (CDU, VDU, delayed cocking, fluid catalytic cracking), and power plants. **Prerequisites:** CHEN 312, CHEN 451, and CHEN 570.

**CHEN 690**  
**Reservoir Engineering**  
3 cr.  
This course covers the mathematical description of the reservoir, organization of reservoir simulation study, and history matching and prediction for several published case studies of reservoir simulations. **Prerequisites:** CHEN 314 and CHEN 490.

**CHEN 796**  
**Engineering Literature Critique**  
1 cr.  
This is a project based course, where students will be asked to conduct an extensive literature review of an assigned engineering topic and present, in both written and oral formats, a critical review of this literature. **Prerequisite:** consent of advisor.

**CHEN 797**  
**Seminar**  
0 cr.  
This is a seminar that consists of presentations on current research or applied projects in chemical engineering or in related fields. Seminars are presented by students, faculty members, or invited scholars. This is a pass/fail course based on attendance.

**CHEN 798**  
**Special Topics in Chemical Engineering I**  
3 cr.  
This class is available to graduate students wishing to gain knowledge in a specific area in which no graduate level classes are offered. The proposed class would involve a directed study for which the student(s) would be given credit. Students wishing to take the class would be assigned a suitable class advisor most familiar with the specific area of interest. Students will be required to present the term work in an organized publication format. **Prerequisite:** consent of advisor.

**CHEN 799**  
**Thesis (A-E)**  
9 cr.