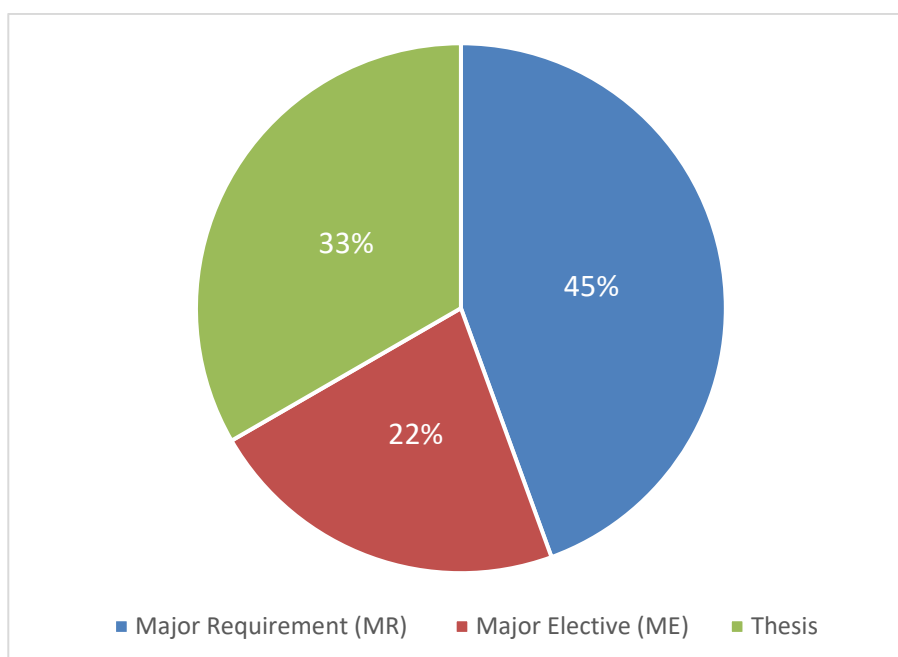


Master of Science in Chemical Engineering 2025

Program Components



University Requirement (UR)	--
College Requirement (CR)	--
General Studies Compulsory (GSCC)	--
Major Requirement (MR)	16
Major Elective (ME) ¹	8
General Studies Elective (GSE) ²	--
Training (Internship) Yes	--
Thesis ²	12
Total Credit (CRD)	36

¹ Student must select four courses (6XX) from the Major Requirement (MR) List. In addition to this, two courses must be selected from the Major Elective (ME) list. This needs consultation and approval of the department.

² Students must select a thesis as a Major Requirement (MR) after completing 12 Credits.

Detailed Study Plan

Year 1 - Semester 1

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEN 611	Advanced Transport Phenomena	4	0	4	M.R.	None	Yes
CHEN 612	Advanced Process Thermodynamics	4	0	4	M.R.	None	Yes
CHEN 613	Advanced Mathematical Methods for Chemical Engineers	4	0	4	M.R.	None	Yes

Year 1 - Semester 2

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEN 614	Advanced Chemical Reaction Engineering	4	0	4	M.R.	None	Yes
CHEN 6xx	Elective Course	4	0	4	M.R.	None	Yes
CHEN 6xx	Elective Course	4	0	4	M.R.	None	Yes

Year 2 - Semester 3

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEN 698	MSc thesis	0	36	12	Thesis	20 CH	Yes

Year 2 - Semester 4

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEN 698	MSc thesis	0	36	12	Thesis	20 CH	Yes

Major Elective Courses

Course Code	Course Title	Course Hours			Course Type	Pre requisite	Major GPA
		LEC	PRAC	CRD			
CHEN 621	Process Safety and Risk Analysis	4	0	4	M.E.	None	Yes
CHEN 622	Process Measurement and Data Management	4	0	4	M.E.	None	Yes
CHEN 623	Process and Energy Integration	4	0	4	M.E.	None	Yes
CHEN 624	Water Desalination	4	0	4	M.E.	None	Yes
CHEN 625	Process Optimization	4	0	4	M.E.	None	Yes
CHEN 626	Advanced Reservoir Engineering	4	0	4	M.E.	None	Yes
CHEN 627	Advances in Petroleum Refinery Engineering	4	0	4	M.E.	None	Yes
CHEN 628	Corrosion Management and Control	4	0	4	M.E.	None	Yes
CHEN 629	Computer Process Control	4	0	4	M.E.	None	Yes
CHEN 630	Fuel Cell Science and Engineering	4	0	4	M.E.	None	Yes
CHEN 631	Environmental Engineering	4	0	4	M.E.	None	Yes
CHEN 632	Biotechnology Applications in Process Engineering	4	0	4	M.E.	None	Yes
CHEN 633	Advances in Petrochemical Processing	4	0	4	M.E.	None	Yes
CHEN 634	Application of Artificial Intelligence in Chemical Engineering	4	0	4	M.E.	None	Yes
CHEN 635	Special Topics	4	0	4	M.E.	None	Yes

Course Description

Course Code: CHEN 611 **Course Title:** Advanced Transport Phenomena

Mechanisms of momentum, heat, and mass transfer within chemical engineering systems. Rigorous analysis and mathematical modeling to explore boundary layer theory and turbulence in complex systems. Application of transport equations in multi-phase systems and reactor designs, providing critical insight into real-world chemical engineering challenges. By integrating computational tools and case studies, students develop the skills necessary to address and solve sophisticated transport-related problems across diverse industrial applications.

Course Code: CHEN 612 **Course Title:** Advanced Process Thermodynamics

Basic concepts, properties of real substances, Property relationships and criteria for chemical and phase equilibria in multicomponent systems. Theoretical treatment of non-ideal multiphase equilibria. Prediction of phase equilibria for vapor, liquid and/or solid systems. Chemically reacting systems: single phase and heterogeneous reactions combined with phase equilibrium. Thermodynamic analysis of chemical processes. Non-equilibrium thermodynamics with applications to chemical reaction kinetics. Optimization of power and refrigeration cycles. Tools: spreadsheet software (e.g., Microsoft® Excel), chemical process flowsheet package (e.g., AspenTech products).

Course Code: CHEN 613 **Course Title:** Advanced Mathematical Methods for Chemical Engineers

Formulation of mathematical problems as applied to the chemical engineering discipline. Review of solution methods for systems of linear and nonlinear algebraic equations. Analytical and numerical methods for solution of ordinary differential equations. Analytical techniques for solution of partial differential equations: combination of variables, separation of variables, orthogonal functions and Sturm-Liouville equation, Laplace and integral transforms, etc. Finite difference techniques. Approximate and numerical methods for solution of partial differential equations. Solution of systems of mixed algebraic and differential equations. Advanced regression techniques.

Course Code: CHEN 614 **Course Title:** Advanced Chemical Reaction Engineering

Characteristics of chemical reactions, complex reactions, heterogeneous reactions, biochemical reactions, polymerization, etc. Behavior and performance of chemical reactors, modeling of real reactors, residence-time distribution models, order and segregation. Effect of transport processes on behavior and performance of reactors, mixing cell sequences, axial dispersion models, stability, sensitivity and optimization. Analysis and design of multiphase reactors. Case studies on gas-solid, gas-liquid and gas-solid-liquid systems.

Course Code: CHEN 621 **Course Title:** Process Safety and Risk Analysis

Toxic hazards and effects of toxicants. Dose/response curves and exposure limits. Release modeling with plume and puff dispersion models. Fire and explosion dynamics, including flash points, flammable limits, ignition, deflagration, and detonation, with prevention strategies. Pressure relief systems and relief device specifications. Hazard identification through HAZOP studies, checklists, and surveys. Risk assessment with accident probability, event and fault trees, risk quantification, and acceptability. Safety management systems and preventive maintenance. Emerging topics such as machine learning in process safety.

Course Code: CHEN 622 **Course Title:** Process Measurement and Data Management

Overview of process measurement system. Component of measurement system. Static and dynamic characteristics of measurement system. Errors in measurement system. Environment of measurement system. Calibration of measurement system. Sensors and transducers: sensors classification, active and passive sensors principle, technology and features. Signal conditioning. Electronic transmitter and smart transmitter. Basic and advanced measurement techniques of common process variables: temperature, pressure, level, and flow measurement. Data acquisition system and measurement data management.

Course Code: CHEN 623 **Course Title:** Process and Energy Integration

Energy Targets and minimum utility requirements. Composite curves. problem Table Algorithm. Construction of grand composite curves. Placement of utilities. Identifying best mix of utilities. Pinch Design Method. Capital Cost Targeting. Capital-energy trade-offs. Automated Design. Network pinch for retrofit. Integration of Heat Engines and Heat Pumps. Integration of Reactors and Separators. Heat Exchanger Network (HEN) Designs. Process Changes Basic,

Plus-minus principle. Data Extraction from process flow sheets. Process Integration versus control and plant-wide control of integrated processes. Basics in Mass Integration

Course Code: CHEN 624 **Course Title:** Advanced Water Desalination Technologies

A comprehensive graduate-level course examining the theoretical principles, design considerations, and operational aspects of water desalination technologies. The course covers water quality standards and regulations, focusing on the analysis and comparison of major desalination processes including reverse osmosis (RO), multi-stage flash (MSF), multi-effect distillation (MED), and vapor compression (VC). Advanced topics include membrane materials and fabrication, hybrid processes, energy recovery systems, process optimization, and techno-economic analysis. The course addresses critical operational challenges such as scaling and fouling, explores environmental impacts, and examines various project delivery models in the desalination industry.

Course Code: CHEN 625 **Course Title:** Process Optimization

Introduction to Optimization. Optimization Problem Formulation. Basic Concepts of Optimization. Linear Programming: The Simplex Method. Integer programming. Unconstrained Single Variable Optimization. Unconstrained Multivariable Optimization: Direct Search Methods & Gradient Based Methods. Constrained Nonlinear Programming. Stochastic programming. Real-world application problems in process engineering.

Course Code: CHEN 626 **Course Title:** Advanced Reservoir Engineering

Comprehensive analysis of reservoir geology: rock properties, traps, temperature, pressure, porosity, permeability, and fluid characteristics. Fluid flow fundamentals in porous media: single and multi-phase flows, relative permeability, capillary pressure, and wettability effects. Reservoir performance analysis through material balance equations for gas, gas condensate, volatile and black oil reservoirs. Primary, secondary, and enhanced oil recovery mechanisms. Production analysis covering water influx, displacement of oil and gas, and decline curve analysis. Pressure transient analysis and diffusivity equations. Reservoir simulation fundamentals using industry software. Tools: Petrel subsurface software.

Course Code: CHEN 627 **Course Title:** Advances in Petroleum Refinery Engineering

Comprehensive analysis of crude oil characterization and properties. Petroleum refinery economics including margin analysis, and crack spreads. Cost estimation for different refinery configurations, incremental variable cost methods, profitability analysis. Key refining processes including separation, conversion, and finishing operations with emphasis on fluid catalytic cracking (FCC), hydrocracking, and product blending. Integration of environmental considerations and waste treatment strategies. Analysis of market factors and future trends in refining technology. Refinery-wide optimization and decision making through case studies. Tools: chemical process flowsheet package (e.g., AspenTech products).

Course Code: CHEN 628 **Course Title:** Corrosion Management and Control

Thermodynamics and kinetics of corrosion. Corrosion environment. Types of corrosion. Anodic protection and passivation. Corrosion inhibitors. Coatings. Cathodic protection. Material selection. Corrosion prevention by design. Corrosion inspection and monitoring. Corrosion strategies and risk management. Quality assurance and quality control. Corrosion economics. Failure analysis and testing. Case study.

Course Code: CHEN 629 **Course Title:** Computer Process Control

Overview of computer process control. Sampling, filtering and signals reconstruction. Modeling of discrete-time systems. The z-transform. Dynamic analysis of discrete-time systems. Stability analysis of discrete-time control systems. Design of digital PID controllers. Design of model-based digital controller. Model predictive control (MPC). Emerging technology for advanced computer process control. Some Case Studies and Applications.

Course Code: CHEN 630 **Course Title:** Fuel Cell Science and Engineering

Fuel cell performance, voltage losses, and polarization curve. Thermodynamics of fuel cells, reversible fuel cell voltage, Nernst equation, fuel cell efficiency. Fuel cell reaction kinetics, electrode kinetics, activation energy and reaction rate of charge transfer reactions, exchange current density, Galvani potential, Butler-Volmer and Tafel equations. Fuel cell mass and charge transport, internal resistance, electrolyte classes, diffusive and convective transport of reactants/products in fuel cell. Fuel cell modeling. Fuel cell stack and system.

Course Code: CHEN 631 **Course Title:** Environmental Engineering

This course offers an advanced exploration of principles and practices essential for solving complex environmental challenges. The course covers key topics including water and wastewater treatment, air pollution control, soil and groundwater remediation, and sustainable waste management. Emphasis is placed on the application of engineering solutions for environmental protection, integrating emerging technologies and sustainable design. Through case studies and real-world applications, students gain the skills and knowledge to design, implement, and manage systems that mitigate environmental impact, preparing them for leadership roles in industry, government, and research.

Course Code: CHEN 632 **Course Title:** Biotechnology Applications in Process Engineering

Biotechnology Systems: Biotechnological trends, aerobic and anaerobic metabolism of micro-organisms, microbial processes, and environmental factors. Enzyme systems: Enzyme production, kinetics, and their industrial utilization. Bioreactor System: stoichiometry of microbial growth, microbial growth kinetics, substrate utilization rate, endogenous respiration, and bioreactor design. Bio-treatment systems: sludge volume index, F/M (food/microorganisms) ratio, sludge treatment and characterization. Other advanced applications (e.g., production of gas, biosurfactant and bioenergy, biological control of air/water pollution, cell-based sensors, tissue engineering, etc.)

Course Code: CHEN 633 **Course Title:** Advances in Petrochemical Processing

This course provides an in-depth exploration of cutting-edge technologies and methodologies in petrochemical processing. It covers advanced topics such as catalytic process innovations, enhanced separation techniques, and sustainable practices in feedstock utilization. Students will examine recent developments in the production of key petrochemicals, process optimization, and integration of environmentally responsible technologies. Through case studies and hands-on problem-solving, the course aims to equip students with the technical and analytical skills needed to address current industry challenges and contribute to advancements in petrochemical engineering.

Course Code: CHEN 634 **Course Title:** Application of Artificial Intelligence in Chemical Engineering

Overview of data science and its relevance to chemical engineering. Fundamental concepts of AI, machine learning, and deep learning. Knowledge-based systems. Statistical data analysis. Strategies for data preprocessing and feature selection. Machine learning for supervised, un-supervised and reinforcement learning, and their applications to chemical engineering problems such as process monitoring, diagnosis, and control, process design, process optimization, etc. All these will be discussed using chemical engineering case studies. Ethical implications of AI in engineering practices.

Course Code: CHEN 635 **Course Title:** Special Topics

This structured course covers advanced topics in chemical engineering and counts only once toward graduation requirements. The course has two primary objectives: first, to introduce new technical electives that address current industrial concerns, expanding the study plan beyond existing offerings. Second, it provides a platform for both new and existing faculty to share their areas of expertise or research interests, enriching the curriculum with specialized knowledge and emerging topics in the field.

Course Code: CHEN 698 **Course Title:** MSc thesis

The MSc research thesis is designed to cultivate advanced research expertise through focused, independent investigation within a student's chosen field. This thesis emphasizes rigorous academic inquiry, critical analytical skills, and hands-on research experience under the mentorship of expert faculty. Students develop advanced methodological and technical skills as they explore meaningful research questions, contributing original insights and innovations to their discipline.