MSc in Chemical Engineering Curriculum

Trimester 1	Trimester 2	Trimester 3
3 Aug 26 to 30 Oct 26	9 Nov 26 to 19 Feb 27	1 Mar 27 to 28 May 26

You may refer to this link for more information on the academic calendar.

Core			
Course Code	**Course title**	**Trimester**	**Academic Unit (AU)**
CH6230	Advanced Reaction Engineering	1	3
CH6240	Advanced Chemical Engineering Thermodynamics	1	3
CH6250	Introduction to Numerical Methods & Machine Learning	1 & 3	3
CH6260	Advanced Process Controls	3	3

Prescribed Electives			
Energy and Sustainability Specialization			
Course Code	**Course title**	**Trimester**	**Academic Unit (AU)**
CH6241	Catalyst Design and Development	3	3
CH6400	Electrochemistry and Electrocatalysis	3	3
CH6410	Nanocatalysis	1	3
CH6261	Renewable Energy and Fuels	2	3

Prescribed Electives			
Pharmaceutical and Fine Chemical Manufacturing Specialization			
Course Code	**Course title**	**Trimester**	**Academic Unit (AU)**
CH6270	Sustainable Pharmaceutical Technology	3	3
CH6280	Formulation of Active Pharmaceutical Ingredients	1	3
CH6281	Case Studies on Pharmaceutical Manufacturing Deviations for Chemical and Biomedical Engineers	3	3
BG6016	Drug Delivery and Nanomedicine	3	3

Prescribed Electives			
Food Science and Technology Specialization			
Course Code	**Course title**	**Trimester**	**Academic Unit (AU)**
CH6500	Analytical Techniques and Food Safety	3	3
CH6501	Human Nutrition – Food Structure, Metabolism, Digestion & Health	1	3
CH6502	International Food Regulation – Impact of Marketing, Nutrition, Environment, and Public Health	2	3
CH6503	Introduction to Food Toxicology and Risk Assessment	2	3

Unrestricted Electives			
Course Code	**Course title**	**Trimester**	**Academic Unit (AU)**
CH6202	Project Management for Engineers	2	3
CH6310	Chemical Process Simulation and Technoeconomic Analysis	2	3
CH6320	Industrial Safety and Operational Excellence	2	3
CH6490	Process Design, Optimization and Supply Chain	1	3
CH6265	Industrial Case Studies	3	3
BG6021	Academic Writing and Statistical Literacy	1	0
BG6022	Laboratory Attachment	1	0
BG6023	MSc Research I	2	3
BG6024	MSc Research II	3	3
BG6025	Professional Internship	1, 2, 3	3

Core Modules

CH6230 - Advanced Reaction Engineering

The objective of this course is to impart and to continue the rigorous study of reaction engineering. In this course, particular emphasis will be given to chemical kinetics and transport phenomena, review of elements of reaction kinetics, rate processes in heterogeneous reacting systems, design of fluid-fluid and fluid-solid reactors, scale-up stability of chemical reactors and residence time analysis of heterogeneous chemical reactors.

CH6240 - Advanced Chemical Engineering Thermodynamics

This course aims to teach chemical thermodynamics at an advanced level, including thermodynamics concepts and principles in relation to open flow systems, ideal and nonideal gas and liquid mixtures, and to apply them on chemical engineering processes, in particular, thermal power cycles, liquefaction, phase equilibria and chemical equilibria. You will also learn practical skills such as numerically constructing thermodynamic equilibria, phase diagrams and other types of diagrams, e.g. Pourbaix diagram and Ellingham diagram.

CH6250 - Introduction to Numerical Methods & Machine Learning

This course introduces the fundamentals of data analytics for solving problems in both engineering and non-engineering contexts. Students will learn to apply numerical methods to understand, optimize, and make data-driven decisions. The course covers the development of algorithms for integration and differential equations, the use of data analytics tools, and the application of machine learning techniques such as regression, classification, and neural networks for modelling and analysis.

CH6260 - Advanced Process Control

This course aims to provide students with a solid foundation in the modeling, analysis, and design of controlled systems. The analysis in this course includes transfer function, time-domain analysis, state-space analysis, controllability, and observability, while the design methods cover PID control, state-feedback control, and optimal control approaches, including linear quadratic regulator and model predictive control. Students will learn to apply advanced control techniques to drive the system towards desired performance. Hands-on exercises and case studies will connect theoretical principles with real-world applications, preparing students to address complex control challenges in various engineering domains.

Prescribed Electives for Energy and Sustainability Specialization

CH6241 - Catalyst Design and Development

This course aims to introduce basic concepts in catalysis and the representative catalytic reactions to the engineering students. The design and development of catalysts in the laboratory and industry are focused. Various types of catalysis such as homogeneous and heterogeneous catalysts, enzymes, polymers, shall be covered. The reaction mechanisms shall be discussed; this module will enable students to define and comprehend principle and practical uses of catalysts.

CH6400 - Electrochemistry and Electrocatalysis

This course aims to provide you with a deep understanding of electrochemistry and electrocatalysis, equipping you with the knowledge and skills to tackle complex challenges in energy conversion and storage. It is designed for students with a background in chemistry, physics, or engineering who are interested in exploring the intersection of these fields. By taking this course, you will gain valuable insights and hands-on experience that are essential for careers in net zero emissions, renewable and sustainable energy, environmental technology, and advanced materials research, as well as for further academic pursuits in related disciplines.

CH6410 - Nanocatalysis

In the nanocatalysis course, you will explore the fundamental principles and innovative applications of nanocatalysts in various chemical processes. This course is designed for graduate students in the fields of chemistry, materials science, and engineering, who are eager to expand their expertise in catalysis at the nanoscale. By participating in this course, you will gain valuable insights and hands-on experience that will not only enhance your research capabilities but also prepare you for exciting career opportunities in academia, industry, and cutting-edge research environments where nanocatalysis plays a crucial role in sustainable development and advanced technology.

CH6261 - Renewable Energy and Fuels

This course serves as a comprehensive foundation course on the principles and applications of sustainable energy and fuels. You will examine renewable energy systems (e.g., solar, biomass, wind, hydro, geothermal), low-carbon fuel technologies (e.g., hydrogen, ammonia, methanol, biomethane), emerging innovations that are central to the global energy transition, and AI for sustainable energy and fuels. This course covers resources, extraction, conversion, and end-use technologies, being intended for students with an interest in energy, environment, or sustainability, particularly those from engineering, science, or related disciplines. By engaging with both theoretical concepts and practical perspectives, you will develop the knowledge

and skills necessary to pursue advanced study, contribute to research, and prepare for professional pathways in the clean energy and sustainability sectors.

Prescribed Electives for Pharmaceutical and Fine Chemical Manufacturing Specialization

CH6270 - Sustainable Pharmaceutical Technology

This course aims to equip you with the latest research and development strategies to enhance the environmental sustainability of manufacturing of pharmaceuticals, including small-molecule active pharmaceutical ingredients and drug biologics (e.g., peptides, proteins). This course covers sustainability enhancement strategies in drug solubility enhancement, environmental footprints reduction, continuous manufacturing platform, and lifecycle analysis. This course will enable you to apply and implement the different approaches available for sustainability enhancement in the pharmaceutical industry.

CH6280 - Formulation of Active Pharmaceutical Ingredients

The objective of the course is to give an insight in drug formulation and the setting of quality specifications. Thus, the course is devoted to the objectives involved in bringing an active pharmaceutical ingredient into an effective and safe dosage form.

CH6281 - Case Studies on Pharmaceutical Manufacturing Deviations for Chemical and Biomedical Engineers

The objective of this course is to build students' ability to critically analyze and solve real-world formulation and manufacturing deviations in the pharmaceutical industry. Using industrial case studies, students will explore challenges in drug production and learn to apply scientific reasoning to practical decision-making. The course emphasizes analytical thinking, problem definition, and innovation, enabling students to diagnose issues, design experiments, and propose sound solutions that improve manufacturing robustness.

BG6016 - Drug Delivery and Nanomedicine

This course aims to provide a broad introduction to contemporary topics in the field of drug delivery and nanomedicine, with an emphasis on the discussions of some key concepts and principles as well as representative systems for the applications of drug delivery and nanomedicine. We will also discuss fundamental science and engineering governing the design, synthesis, properties and applications of various systems. This course will provide students an opportunity to gain knowledge, insights, skills and expertise in this field, supporting them for future careers in relevant academia and industries.

Prescribed Electives for Food Science and Technology Specialization

CH6500 - Analytical Techniques and Food Safety

In Analytical Techniques and Food Safety, you will gain the knowledge and practical skills to identify, measure, and evaluate chemical, biological, and physical hazards in food, applying modern analytical methods to ensure compliance with safety standards. This course is designed for students in food science, chemistry, biology, nutrition, or related fields who want to deepen their expertise in laboratory analysis and regulatory requirements. By taking this course, you will not only strengthen your scientific problem-solving abilities but also prepare yourself for careers in food safety testing, quality control, research and development, or for further study in advanced analytical science, positioning you to make a direct impact on public health and the global food supply chain.

CH6501 - Human Nutrition – Food Structure, Metabolism, Digestion & Health

This course aims to bring about an understanding of the interactions between food structures, digestion and gut health. This course will provide an understanding of the role of food structure has, in modifying digestion and the release of nutrients from the food. Natural foods contain important structural components at the molecular, nano-, micro-, and meso-structural scale. It is important to be aware of how various food processing modifies and often destroys these structures and thus modifies the digestion profile of nutrients. The student will be armed with the understanding of how to manufacture foods that release nutrients in ways that mimics natural foods, thus ensuring nutrients are provided, following consumption. This will be especially useful in today's growing demand for food, which in turn drives the food processing industry.

CH6502 - International Food Regulation – Impact of Marketing, Nutrition, Environment, and Public Health

This course aims to bring about awareness of international regulatory bodies and policy topics related to food, and the problems of the modern global food system. The emergence of novel and alternative foods requires global coordination to assess their safety risk, harmonization and standardization of the individual efforts. The global food landscape has undergone significant transformation in recent decades, with international trade agreements and regulatory frameworks reshaping how nations approach food safety. Today’s interconnected food supply chains mean that what happens in one part of the world inevitably affects food safety practices everywhere. Understanding how the changing international environment impacts food safety regulations is crucial for students and professionals alike who aim to navigate the complex world of global food systems. The changing international environment has fundamentally reshaped food safety regulation through WTO agreements which mandate scientific justification and risk assessment as the basis for legitimate measures. The Codex Alimentarius Commission provides international standards that serve as benchmarks for national regulations, helping to harmonize food safety practices globally while minimizing unnecessary trade barriers. For students and professionals in food safety, understanding these international dimensions is

essential for navigating both regulatory compliance and market access in an increasingly interconnected global food system.

CH6503 - Introduction to Food Toxicology and Risk Assessment

In the Introduction to Food Toxicology and Risk Assessment course, you will explore the principles of human safety assessment for food, chemicals, and related products, and gain hands-on familiarity with key risk assessment methodologies and procedures. This course is designed for students across food science, chemistry, chemical and biomedical engineering, medical sciences, and related disciplines who want to understand how toxicology, ADME, dose-response modeling, and exposure assessment inform safety decisions. By participating in this course, you will critically evaluate chemicals of interest, including food additives, natural products, mycotoxins, pesticides, and other bioactive compounds, through case studies and applied examples, equipping you with the knowledge and skills needed for careers in food and chemical safety, regulatory affairs, research, and industry, where rigorous risk assessment ensures human health and product safety.

Unrestricted Electives

CH6202 - Project Management for Engineers

This course aims to introduce basic concepts in project management to the engineering students. This equips the engineers to improve their employability in the industry and helps in their career growth. Some of the key concepts such as project integration, scope management, project planning, project budget & cost management, project risks and opportunities, communication and conflict management shall be covered. This module will enable students to define and plan a project with proper understanding of engineers' role.

CH6310 - Chemical Process Simulation and Technoeconomic Analysis

This course is intended for those of you who are new to process design or those who need to refresh and deepen your knowledge about process design and simulation. In this course, you will learn to effectively synthesize a process flow diagram by applying and integrating various chemical engineering principles and implementing techno-economic evaluation method with the aid of process simulation software, such as Aspen Plus and/or HYSYS.

CH6320 – Industrial Safety and Operational Excellence

This course aims to teach you about process plant safety engineering, quality controls, assurance and operational excellence at an advanced level; to understand and application of technical foundational tools used to design, manage, operate safely and efficiently at chemical, oil & gas, pharmaceutical and semiconductor industries. The intent is also to learn more about inherently safer designs, quality

management system and to develop advanced Safety and Quality Competencies with a comprehensive understanding of risk assessment methodologies, to eliminate and mitigate hazards and quality defects. To promote Operational Efficiency as to foster the ability to apply lean manufacturing via Total productive maintenance programs and best practice techniques to enhance productivity, efficiency while elevating foundational metrics to world class through operational excellence.

CH6490 – Process Design, Optimization and Supply Chain

This course aims to develop simulation skills to consider complex process design in the context of cost, and sustainable process plant development. It equips with a systematic design methodology to design key unit operations (i.e. reactor, separator, and heat exchanger) in a chemical plant, with an emphasis on the conceptual issues that are fundamental to the process creation. Linear, Mixed-Integer Linear and nonlinear programming is studied. Process simulation and modelling tools (e.g. MATLAB/GAMS) are explored and several Case studies on process optimization are discussed. One part of this course will also introduce Supply Chain Management and supply chain networks will be studied and Strategic, tactical and Operational decisions that optimizes supply chain performance will be explored.

BG6021 - Academic Writing and Statistical Literacy

Academic Writing and Statistical Literacy is a pass/fail course comprising thirteen two-hour lessons. The course develops students' ability to produce clear, coherent, and well-structured academic writing while building a foundational understanding of statistical concepts and their application in academic contexts. Students will learn to interpret, analyze, and present quantitative data effectively, and to integrate statistical evidence into logical and persuasive written arguments. Emphasis is also placed on strengthening critical thinking in evaluating research findings and data sources, as well as cultivating academic integrity through proper citation, referencing, and ethical use of data. The course prepares students to conduct and communicate research effectively across academic disciplines.

BG6022 - Laboratory Attachment

This course offers students the opportunity to engage in research activities under the guidance of faculty members within the School of Chemistry, Chemical Engineering and Biotechnology. Students are expected to undertake a 10-week laboratory attachment with a faculty member of the school. Designed as an introductory research immersion experience, its primary aim is to familiarize students with different sub-disciplines and techniques related to their main interest, as well as fundamental protocols and techniques employed in academic research laboratories. The student is expected to immerse him/herself in the laboratory chosen to gain direct exposure working in the laboratory, interact with members of the laboratory that are at various stages of training and career development, and obtain a basic understanding of the research interests and the key research approaches of the laboratory.

BG6023 - MSc Research I / BG6024 - MSc Research II

MSc research project is specifically crafted for students to work on technology development in a research setting under the guidance of a faculty member. The project is required to involve some degree of new and original research, not just a review of previous work. Conducting relevant research provides students with opportunities to further apply the theoretical knowledge and analytical skills developed in the courses taken.
*Prerequisite: BG6022

BG6025 - Professional Internship

This Graduate Internship programme is offered as an optional course for all cceb coursework students. The purpose of this Internship is to enable the application of knowledge and skills you have learned in the university in an authentic work environment. You can gain exposure and develop practical industry experience that will enhance your employability and lifelong learning capabilities. Moreover, you may be able to get a head start in your career if you apply to the same company later.