BACHELOR OF ENGINEERING IN CHEMICAL AND PETROCHEMICAL ENGINEERING

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campuses Where The Program Is Offered: Regular Preparatory: CST, CLN, CLS, CZB – Honors Preparatory and Bachelor of Engineering: CST

OBJECTIVES

Objectives – Honors Preparatory Chemical and Petrochemical Engineering
The Chemical and Petrochemical Engineering program aims to enable students to:
- Pursue successful professional careers by skillfully solving emerging engineering problems.
- Contribute to the sustainable growth and development of society.
- Sustain intellectual curiosity and further expand their knowledge and skills allowing them to assimilate the advances in the profession in a changing world.
- Assume leadership roles while respecting diversity and ethical practices.

Objectives – Regular Preparatory Chemical and Petrochemical Engineering
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Objectives – Bachelor of Engineering in Chemical and Petrochemical Engineering
The Bachelor of Engineering in Chemical and Petrochemical Engineering aims to enable students to:
- Pursue successful professional careers by skillfully solving emerging engineering problems.
- Contribute to the sustainable growth and development of society.
- Sustain intellectual curiosity and further expand their knowledge and skills allowing them to assimilate the advances in the profession in a changing world.
- Assume leadership roles while respecting diversity and ethical practices.

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

Competencies – Honors Preparatory Chemical and Petrochemical Engineering
- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- An ability to apply engineering design to produce solutions that meet specific needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to effectively communicate with a range of audiences.
- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- An ability to effectively function on a team whose members provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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PROGRAM REQUIREMENTS

Students are required to choose either the Honors Preparatory track or the Regular Preparatory track. Once the two years of the chosen track are completed, they join the three-year Bachelor of Engineering program.

Honors Preparatory Chemical and Petrochemical Engineering
120 credits: Required courses (120 credits including 10 credits for USJ General Education Program)

Required Courses (120 Cr.)
Algebra 1 (6 Cr.). Algebra 2 (6 Cr.). Algebra 3 (4 Cr.). Analysis 1 (4 Cr.). Analysis 2 (6 Cr.). Analysis 3 (4 Cr.). Discrete Mathematics (6 Cr.). General Analysis (6 Cr.). Advanced General Chemistry (4 Cr.). Electromagnetism (4 Cr.). General Chemistry (4 Cr.). General Chemistry Laboratory (2 Cr.). Inorganic Chemistry and Laboratory (2 Cr.). Magnetic Induction (2 Cr.). Mechanics 1 (6 Cr.). Mechanics 2 (4 Cr.). Organic Chemistry and Laboratory (2 Cr.). Physical Signals (6 Cr.). Physics Laboratory 1 (2 Cr.). Physics Laboratory 2 (2 Cr.). Quantum Physics (2 Cr.). Signal Processing (2 Cr.). Thermodynamics 1 (6 Cr.). Thermodynamics 2 (2 Cr.). Wave Optics (2 Cr.). Programming 1 (4 Cr.). Programming 2 (4 Cr.). Programming 3 (2 Cr.). Geology (2 Cr.). Introduction to Fluid Mechanics (2 Cr.). Supervised Personal Initiative Work (2 Cr.). Engineering at the Service of the Community (2 Cr.). French and Philosophy 1 (2 Cr.). French and Philosophy 2 (2 Cr.). USJ Values in Daily Life (2 Cr.).

Regular Preparatory Chemical and Petrochemical Engineering
120 credits: Required courses (116 credits), Open elective courses (4 credits), USJ General Education Program (10 credits, may be part of the above categories).

Required Courses (116 Cr.)
Analysis 1 (4 Cr.). Analysis 2 (6 Cr.). Bilinear Algebra and Geometry (6 Cr.). Differential Calculus (6 Cr.). Discrete Mathematics (6 Cr.). General Analysis (6 Cr.). Linear Algebra (8 Cr.). Probability (4 Cr.). Supplemental Mathematics (2 Cr.). Atomic Structure and Chemical Bonding (2 Cr.). General Chemistry (4 Cr.). General Chemistry Laboratory

(2 Cr.). Inorganic Chemistry and Laboratory (4 Cr.). Kinetics of Chemical Reactions (2 Cr.). Mechanics 1 (6 Cr.). Mechanics 2 (4 Cr.). Organic Chemistry (4 Cr.). Organic Chemistry Laboratory (2 Cr.). Physical Signals (6 Cr.). Physics Laboratory 1 (2 Cr.). Thermodynamics 1 (4 Cr.). Thermodynamics 2 (4 Cr.). Programming 1 (4 Cr.). Programming 2 (4 Cr.). Computer-Aided Design (4 Cr.). Geology (2 Cr.). Introduction to Engineering Projects (2 Cr.). Introduction to Fluid Mechanics (2 Cr.). Engineering at the Service of the Community (2 Cr.). USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

Bachelor of Engineering in Chemical and Petrochemical Engineering
180 credits: Required courses (152 credits), Institution's elective courses (26 credits), Open elective courses (2 credits), and USJ General Education Program (26 credits - may be part of the above categories).

Fundamental Courses (178 Cr.)
Required Courses (152 Cr.)
Business Law (2 Cr.). Chemical Kinetics/Heterogeneous Catalysis (2 Cr.). Chemical Thermodynamics (4 Cr.). Chemistry of Polymers (4 Cr.). Communication Skills (2 Cr.). Contactors: Systems G-L, F-S, L-L (4 Cr.). Dynamics and Process Control (4 Cr.). Energy Management Applied to Processes and Utilities (2 Cr.). Engineering Ethics (4 Cr.). English (4 Cr.). Fermentation Processes (2 Cr.). Final Year Project (16 Cr.). Fluid Mechanics (4 Cr.). Formulation Processes (2 Cr.). Ideal and Non-Ideal Reactors (4 Cr.). Industrial Chemistry (4 Cr.). Summer Internship (2 Cr.). Summer Internship II (2 Cr.). Introduction to Continuous and Discontinuous Processes (4 Cr.). Mass and Energy Balances (6 Cr.). Mass Transfer (4 Cr.). Mathematical Techniques in Chemical Engineering (6 Cr.). Mechanical Agitation and Transfer (2 Cr.). Modeling and Simulation (2 Cr.). Numerical Analysis (4 Cr.). Petrochemical Processes (4 Cr.). Process Design Project (6 Cr.). Process Engineering Lab (2 Cr.). Process Equipment Design (4 Cr.). Production Management (2 Cr.). Programming and Databases (4 Cr.). Project Management (2 Cr.). Quality, Health, Safety (2 Cr.). Refining Processes (6 Cr.). Separation Techniques (6 Cr.). Statistics (4 Cr.). Theoretical Chemistry (4 Cr.). Thermal Engineering (4 Cr.). Total Synthesis and Activation Methods (2 Cr.). Unit Operations: Adsorption, Drying, Crystallization (4 Cr.).

Institution's Elective Courses (26 Cr.)
Six courses to be chosen from the following list:
Biochemical Techniques and Instrumentation (4 Cr.). Composite Materials (4 Cr.). Cosmetic Technology (4 Cr.). Design and Construction of Wells (4 Cr.). Digital Technologies Applied to Chemical Engineering (4 Cr.). Drilling Technology (4 Cr.). Food Manufacturing and Packaging (4 Cr.). Microbiology-Enzymatic Catalysis (4 Cr.). Petroleum Production (4 Cr.). Pharmaceutical Process Design (4 Cr.). Reservoir Engineering (4 Cr.). Solid and Hazardous Waste Management (4 Cr.). Statistical Analysis and Design of Pharmaceutical Operations (4 Cr.). Tribology and Lubricants (4 Cr.). Wastewater Treatment (4 Cr.).
One Institution's Elective Course to choose between: Entrepreneurship (2 Cr.) or Work Ready Now (2 Cr.)

Open Elective Course (2 Cr.)

USJ General Education Program (10 out of 36 Cr.) - Honors Preparatory Chemical and Petrochemical Engineering, Regular Preparatory Chemical and Petrochemical Engineering
26 additional credits are validated in the Department of Chemical and Petrochemical Engineering

Code	Course Name	Credits
	HUMANITIES	**4**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	**2**
020GSCCI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADCI1	Discrete Mathematics	6

USJ General Education Program (26 out of 36 Cr.) - Bachelor of Engineering in Chemical and Petrochemical Engineering
10 additional credits are validated in the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGCS4	English	4
	ARABIC	**4**
	Arabic Language and Culture	**2**
435LALAL2 435LALML2 435LRCTL2	One Arabic Culture and Language course to be selected among: Arabic Language and Media Arabic Language and Arts Arabic Language: Contemporary Novel, Cinema, and Theater	2
	Other Course Taught in Arabic	**2**
020DROCS2	Business Law	2
	HUMANITIES	**4**
	Ethics	**4**
020ETHCS1	Engineering Ethics	4
	SOCIAL SCIENCES	**6**
	Professional Integration and/or Entrepreneurship	**2**
020ENPCS4 020WORCS4	One Institution's elective course to be selected between: Entrepreneurship Work Ready Now	2
	Other Social Sciences Courses	**4**
020GEPCS4	Production Management	2
020GPRCS5	Project Management	2
	COMMUNICATION TECHNIQUES	**8**
020COMCS2	Communication Skills	2
020PDPCS4	Process Design Project	2 out of 6
020MFECS6	Final Year Project	4 out of 16

SUGGESTED STUDY PLAN

Students are required to choose either the Honors Preparatory track or the Regular Preparatory track. Once the two years of the chosen track are completed, they join the three-year Bachelor of Engineering program.

Semester 1

Code	Course Name	Credits
	Required Courses - Honors Preparatory Chemical and Petrochemical Engineering	
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 1	6
020SPHCI1	Physical Signals	6
	Total	**30**
	Required Courses - Regular Preparatory Chemical and Petrochemical Engineering	

020MADNI1	Discrete Mathematics	6
020GSCNI1	Engineering at the Service of the Community	2
020ANGNI1	General Analysis	6
020CHGNI1	General Chemistry	4
020MC1NI1	Mechanics 1	6
020SPHNI1	Physical Signals	6
020CMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
	Required Courses - Honors Preparatory Chemical and Petrochemical Engineering	
020AL1CI2	Algebra 1	6
020AA1CI2	Analysis 1	4
020FR1CI2	French and Philosophy 1	2
020TCGCI2	General Chemistry Laboratory	2
020INMCI2	Magnetic Induction	2
020PP1CI2	Physics Laboratory 1	2
020IF1CI2	Programming 1	4
020TH1CI2	Thermodynamics 1	6
	Total	**28**
	Required Courses - Regular Preparatory Chemical and Petrochemical Engineering	
020AA1NI2	Analysis 1	4
020ATONI2	Atomic Structure and Chemical Bonding	2
020TCGNI2	General Chemistry Laboratory	2
020ALNNI2	Linear Algebra	8
020PP1NI2	Physics Laboratory 1	2
020IF1NI2	Programming 1	4
020TH1NI2	Thermodynamics 1	4
	Open Elective Course	2
	Total	**28**

Semester 3

Code	Course Name	Credits
	Required Courses - Honors Preparatory Chemical and Petrochemical Engineering	
020CHACI3	Advanced General Chemistry	4
020AL2CI3	Algebra 2	6
020AN2CI3	Analysis 2	6
020EMECI3	Electromagnetism	4
020FR2CI3	French and Philosophy 2	2
020MC2CI3	Mechanics 2	4
020PP2CI3	Physics Laboratory 2	2
020IF2CI3	Programming 2	4

020TRSCI3	Signal Processing	2
020OPTCI3	Wave Optics	2
	Total	**36**
	Required Courses - Regular Preparatory Chemical and Petrochemical Engineering	
020AN2NI4	Analysis 2	6
020ALBNI3	Bilinear Algebra and Geometry	6
020MC2NI3	Mechanics 2	4
020CORNI3	Organic Chemistry	4
020IF2NI3	Programming 2	4
020TH2NI3	Thermodynamics 2	4
064VALEL1	USJ Values in Daily Life	2
	Total	**30**

Semester 4

Code	Course Name	Credits
	Required Courses - Honors Preparatory Chemical and Petrochemical Engineering	
020AL3CI4	Algebra 3	4
020AN3CI4	Analysis 3	4
020GELCI4	Geology	2
020CIOCI4	Inorganic Chemistry and Laboratory	2
020IMFCI4	Introduction to Fluid Mechanics	2
020CORCI4	Organic Chemistry and Laboratory	2
020IF3CI4	Programming 3	2
020PHQCI4	Quantum Physics	2
020TIPCI4	Supervised Personal Initiative Work	2
020TH2CI4	Thermodynamics 2	2
064VALEL1	USJ Values in Daily Life	2
	Total	**26**
	Required Courses - Regular Preparatory Chemical and Petrochemical Engineering	
020COANI4	Computer-Aided Design	4
020CDFNI4	Differential Calculus	6
020GELNI4	Geology	2
020CITNI4	Inorganic Chemistry and Laboratory	4
020PIINI4	Introduction to Engineering Projects	2
020IMFNI4	Introduction to Fluid Mechanics	2
020CIHNI4	Kinetics of Chemical Reactions	2
020PCONI4	Organic Chemistry Laboratory	2
020PRBNI4	Probability	4
	Open Elective Course	2
	Total	**30**

Semester 5

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Chemical and Petrochemical Engineering	
020CCHCS1	Chemical Kinetics/Heterogeneous Catalysis	2
020THCCS1	Chemical Thermodynamics	4
020CHPCS1	Chemistry of Polymers	4
020ETHCS1	Engineering Ethics	4
020BMECS1	Mass and Energy Balances	6
020ANNCS1	Numerical Analysis	4
020IBDCS1	Programming and Databases	4
020CHTCS1	Theoretical Chemistry	4
	Total	**32**

Semester 6

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Chemical and Petrochemical Engineering	
020DROCS2	Business Law	2
020COMCS2	Communication Skills	2
020MEFCS2	Fluid Mechanics	4
020RNICS2	Ideal and Non-ideal Reactors	4
020CHICS2	Industrial Chemistry	4
020PROCS2	Introduction to Continuous and Discontinuous Processes	4
020PDTCS2	Mass Transfer	4
020QHSCS2	Quality, Health, Safety	2
020STACS2	Statistics	4
020STMCS2	Total Synthesis and Activation Methods	2
	Open Elective Course	2
	Total	**34**

Semester 7

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Chemical and Petrochemical Engineering	
020DCPCS3	Dynamics and Process Control	4
020ST1CS3	Summer Internship I	2
020MOSCS3	Modeling and Simulation	2
020PRPCS3	Refining Processes	6
020TESCS3	Separation Techniques	6
020GTHCS3	Thermal Engineering	4
020OPUCS3	Unit Operations: Adsorption, Drying, Crystallization	4
	Institution's Elective Courses	4
	Total	**32**

Semester 8

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Chemical and Petrochemical Engineering	
020CONCS4	Contactors: Systems G-L, F-S, L-L	4
020ANGCS4	English	4
020TMCCS4	Mathematical Techniques in Chemical Engineering	6
020AMTCS4	Mechanical Agitation and Transfer	2
020PPCCS4	Petrochemical Processes	4
020PDPCS4	Process Design Project	6
020CEPCS4	Process Equipment Design	4
020GEPCS4	Production Management	2
	Institution's Elective Courses	2
	Total	**34**

Semester 9

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Chemical and Petrochemical Engineering	
020GEACS5	Energy Management Applied to Processes and Utilities	2
020PFOCS5	Formulation Processes	2
020BRFCS5	Fermentation Processes	2
020ST2CS5	Summer Internship II	2
020GEPCS5	Process Engineering Lab	2
020GPRCS5	Project Management	2
	Institution's Elective Courses	20
	Total	**32**

Semester 10

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Chemical and Petrochemical Engineering	
020MFECS6	Final Year Project	16
	Total	**16**

COURSE DESCRIPTION

Honors Preparatory Chemical and Petrochemical Engineering

020CHACI3 Advanced General Chemistry 4 Cr.

This course provides students with the basic principles of chemical thermodynamics as well as electrochemistry including: the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, and phase equilibria; equilibrium constant; characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium; optimization of a chemical process; overvoltage: current-potential curves; spontaneous transformations; batteries and electrolyzers; mixed potential, corrosion potential, corrosion current intensity, and uniform corrosion in acidic or neutral oxygenated medium; differential corrosion by heterogeneity of the support or the environment; protection against corrosion.
Prerequisite: General Chemistry (020CHGCI1).

020AL1CI2 Algebra 1 6 Cr.

This course covers algebraic structures, vector spaces, linear applications, matrices, determinants, linear systems, and Euclidean spaces.

020AL2CI3 Algebra 2 6 Cr.

This course explores the advanced study of algebraic structures such as groups, rings, and fields. It includes a detailed examination of endomorphisms, matrix reduction, and special substructures of algebraic structures like ideals. Topics explored include classification of matrices, the computation of eigenvalues, and matrix equivalence. With a mix of theoretical understanding and practical applications, students will gain a comprehensive understanding of these mathematical concepts.
Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.

This advanced course is divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 2, this course provides students with a comprehensive understanding of these mathematical disciplines.
Prerequisites: Algebra 2 (020AL2CI3) - Analysis 1 (020AA1CI2).

020AA1CI2 Analysis 1 4 Cr.

This course covers the following: Asymptotic analysis: Taylor series- Integration on a segment: integration and derivation- Riemann's sum- Real and complex series, series with positive terms, convergence and absolute convergence- Combinatorics: Cartesian product, arrangements, combinations, finite sets cardinality, probability on a finite space, Bayes formula, independence, and finite random variables.

020AN2CI3 Analysis 2 6 Cr.

This course covers the following: Normed vector spaces: continuity, uniform continuity and Lipschitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, and line integrals.
Prerequisite: Analysis 1 (020AA1CI2).

020AN3CI4 Analysis 3 4 Cr.

This course covers the series and summable families, sequences and series of functions, integration and derivation of a series of functions, power series, probability and discrete random variables, linear differential equations and systems of the form X'=A(t)X+B(t), the method of constant variation, and Lagrange's method.
Prerequisite: Analysis 2 (020AN2CI3).

020MADCI1 Discrete Mathematics 6 Cr.

This course covers the following: Logic and reasoning, Set theory, Applications, Binary relations, Algebraic calculations, Complex numbers, Integer arithmetic, and Polynomials.

020EMECI3 Electromagnetism 4 Cr.

This course starts with a separate study of the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell's equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is focused on the propagation of EM waves in vacuum, in conductors, in plasma, and far away from an EM oscillating dipole.
Prerequisites: Physical Signals (020SPHCI1) - General Analysis (020ANGCI1).

020GSCCI1 Engineering at the Service of the Community 2 Cr.

This course aims to explore the role of engineers in modern society, with a particular focus on innovation, renewable energies, green buildings, design, food security, recycling, and other areas relevant to our daily lives. Students will learn how engineers can leverage their technical skills, knowledge, and tools to address and solve social and environmental challenges through engineering.

020FR1CI2 French and Philosophy 1 2 Cr.

This course is offered to students in Higher Mathematics - Competition Section *(Mathématiques supérieures - section Concours)* to prepare them for the written French test in the admission competition for polytechnic schools (*Filière Universitaire Internationale-Formation Francophone FUI-FF).* Its objective is to provide students with the academic and didactic tools necessary for success in the admission test.

020FR2CI3 French and Philosophy 2 2 Cr.

This course is offered to students in Advanced Mathematics - Competition Section (*Mathématiques spéciales - section Concours*) to prepare them for the written French test in the admission competition for polytechnic schools (*Filière Universitaire Internationale-Formation Francophone FUI-FF*). Its objective is to provide students with the academic and didactic tools necessary for success in the admission test.

020ANGCI1 General Analysis 6 Cr.

This course covers a set of real numbers, real functions, trigonometric functions, logarithmic functions, power functions, inverse trigonometric functions, hyperbolic functions, linear first order differential equations, second order differential equations with constant coefficients, real and complex sequences, limits and continuity of real functions, differentiability, Rolle's Theorem, and applications.

020CHGCI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students will also learn the concept of heterogeneous equilibrium in aqueous solution, the effect of the common ion and of complexation on solubility, complexation reactions and the influence of pH on solubility. Finally, this course allows analyzing potential-pH diagrams through examples along vertical and horizontal lines.

020TCGCI2 General Chemistry Laboratory 2 Cr.

This course focuses on the comprehension of hazards and risks, as well as the identification of relevant safety guidelines. It aims to enhance students' knowledge regarding laboratory procedures, techniques, and safety protocols. Additionally, the course aims to develop students' skills in qualitative chemical analysis and titration of various mineral solutions, including acids, alkaline solutions, and precipitation reactions. Furthermore, students will learn to verify theoretical information through the determination of concentrations using electrochemical analysis methods such as spectrophotometric analysis. This course also familiarizes students with the equipment used in each laboratory session and establishes a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGCI1).

020GELCI4 Geology 2 Cr.

This course aims to introduce fundamental concepts of geology. It focuses on structural geology, stratigraphy, and petrography. It covers the brittle and ductile deformation and explains the behavior of material in front of different kinds of stress, extensive and compressional. It also presents the different types of rocks, their genesis contexts, their physical properties and their organoleptic classification.

020CIOCI4 Inorganic Chemistry and Laboratory 2 Cr.

This course allows students to acquire solid skills in the field of crystallography: compact and pseudo-compact stacking of metals, interstitial sites, metallic alloys, and metallic bonds. In addition, this course allows them to master basic notions on ionic solids through examples as well as on the solubility of a solid in binary systems through equilibrium diagrams. In addition, part of this course is dedicated to the study of the physical and chemical properties of certain chemical elements. This course is supplemented by laboratory work on the preparation of double salts and hydrogen peroxide, the determination of water hardness and the purification of calcium carbonate.

020IMFCI4 Introduction to Fluid Mechanics 2 Cr.

This course covers the following: Fluid properties, hydrostatic law, Pascal law, Archimedes law, Hydrostatic force on plane and curved surfaces. Lines of flow, types of flow, velocity field and acceleration, continuity equation, Equation of streamline, stream function, velocity potential function, circulation, vorticity, irrotational and rotational flow, compressible and incompressible flows, Lagrange and Euler description.

020IMFCI4 Introduction to Fluid Mechanics 2 Cr.

This course covers the following: Fluid properties, hydrostatic law, Pascal law, Archimedes law, Hydrostatic force on plane and curved surfaces. Lines of flow, types of flow, velocity field and acceleration, continuity equation, Equation of streamline, stream function, velocity potential function, circulation, vorticity, irrotational and rotational flow, compressible and incompressible flows, Lagrange and Euler description.

020INMCI2 Magnetic Induction 2 Cr.

This course introduces students to the magnetic field beyond the descriptive approach studied in high school. It covers practical applications such as compasses, electric motors, alternators, transformers, speakers, induction plates, and radio-frequency identification. The course also presents the concept of magnetic flux and generalizes the magnetic dipole of a current circuit to magnets.

020MC1CI1 Mechanics 1 6 Cr.

This course enables students to master the principles and fundamental concepts of classical physics (inertia principle, fundamental principle of dynamics, principle of reciprocal actions, work-energy theorem). This course reinforces understanding of these principles through a wide range of concrete applications or real-life situations with all their richness, particularly in the field of engineering.

020MC2CI3 Mechanics 2 4 Cr.

This course focuses on the study of specific topics within the field of classical mechanics. Its primary objective is to provide students with a deeper understanding of non-inertial reference frames, friction phenomena, and solid rotation around a fixed axis. In the realm of non-inertial reference frames, students explore the principles and equations necessary to analyze and solve problems involving accelerated systems. They will learn to account for the effects of fictitious forces, such as centrifugal and Coriolis forces, which arise in non-inertial frames. The course also delves into the intricate nature of friction, examining its various types and the factors affecting its magnitude. Students will acquire the skills to analyze the behavior of objects subject to both static and kinetic friction. Lastly, the study of solid rotation around a fixed axis enables students to comprehend the kinematics and dynamics of rotating bodies, including concepts like angular velocity, angular acceleration, and moments of inertia. Overall, this course equips students with the fundamental knowledge and problem-solving abilities necessary to tackle complex mechanical systems involving non-inertial reference frames, frictional forces, and solid rotation.
Prerequisite: Mechanics 1 (020MC1CI1).

020CORCI4 Organic Chemistry and Laboratory 2 Cr.

This course begins with an introduction to organic chemistry, naming of organic molecules and their spatial representation. It enables students to master stereoisomerism and the reactivity of molecules: inductive and mesomeric effects, nucleohilic and electrophilic reagents. Then the reaction in organic chemistry is explained and the following organic compounds are studied: halogenated derivatives – alkenes and alkynes – benzene and aromatic compounds – alcohols (substitution, elimination, oxidation) – carbonyl compounds (substitution on the acyl group) – reactions of aldehydes and ketones – carboxylic acids, esters, amides and amines. After each part addressed, tutorials are treated in order to master the concept. Practical works are also conducted to let students master the methods of extraction, filtration, purification, and synthesis of organic products.

020SPHCI1 Physical Signals 6 Cr.

The course is concerned with a wide range of concepts already introduced at high school: periodic signals, spectrums, electrical energy, Ohm's law, Joule's law, lenses, wavelength, light spectrum, numerical signal, travelling wave, diffraction, interferences, Doppler effect, Newton's law, mechanical energy, harmonic oscillator. It assures a smooth transition toward a more quantitative physics than the one seen at high school.

020PP1CI2 Physics Laboratory 1 2 Cr.

This practical work course is designed to bridge the gap between theoretical knowledge and practical application in the field of electrical engineering and physics. Throughout the course, students will engage in hands-on activities to gain a deeper understanding of various concepts. The key topics covered include resonance in RLC circuits, system analysis, circuit measurements, mechanics and motion, LabVIEW software, fields and characteristics, oscilloscope applications, single-degree-of-freedom oscillator, focal measurement, and optical systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts.

020PP2CI3 Physics Laboratory 2 2 Cr.

This course allows students to solidify their theoretical knowledge by putting it into practice through a variety of topics. They will have the opportunity to explore areas such as electrical circuits, linear filters, Fourier analysis, frequency analysis, the Thomson tube, thermal conduction, the Stefan-Boltzmann law, the oscillator with two degrees of freedom, diffraction and interference, as well as polarization.
Prerequisite: Physics Laboratory 1 (020PP1CI2).

020IF1CI2 Programming 1 4 Cr.

This course covers the hardware components of a computer and the basic concepts of high-level programming using Python. The topics addressed include the computer's hardware components, algorithms, programming languages, Python and the IDLE environment, variables, arithmetic expressions and operators, primitive data types, input and output of data, built-in composite data types, simple statements, control statements, logical expressions, relational and logical operators, function definition and call, functions from external modules.

020IF2CI3 Programming 2 4 Cr.

This course covers LIFO and FIFO structures - Topics include a systematic study of existing sorting algorithms and how to calculate their time complexity. It also covers the basic concepts of object-oriented programming and their application to data abstraction by introducing the concepts of object instantiation, attributes, and methods. It also covers an introduction to relational databases.
Prerequisite: Programming 1 (020IF1CI2).

020IF3CI4 Programming 3 2 Cr.

This course covers the following: Ce Programming and algorithms with Categorical Abstract Machine Language (CAML) – variables, arithmetic expressions and operators, primitive data types, data input and output, built-in composite data types, simple statements, control statements, logical expressions, relational and logical operators, function definition and call, functions from external modules – array – dynamic programming – recursive structures (lists, trees) – LIFO – FIFO – complexity – graph – propositional logic – deterministic and non-deterministic finite state automata – regular expressions.
Prerequisite: Programming 1 (020IF1CI2).

020PHQCI4 Quantum Physics 2 Cr.

This course is concerned with two aspects of modern physics. The first is based on the Schrodinger formulation of the wave mechanics and treats simple but fundamental problems: free particle, particle in a single-step potential, tunnel effect, particle in a box and energy quantization. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discrete spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.

This course aims to provide students with a thorough understanding of key concepts related to filtering of periodic signals and sampling. Students will have the opportunity to deepen their knowledge of linear filters, understanding their operation and exploring the effects of first and second-order filters on a periodic signal. Special attention is given to the sampling process, with a detailed study of the Nyquist-Shannon theorem, which establishes the necessary conditions to avoid spectrum folding. Additionally, students will have the opportunity to become familiar with digital filtering.
Prerequisite: Physical Signals (020SPHCI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.

This course enables students to undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.
Students will conduct research, analyze reality, and identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 1 6 Cr.

This course focuses on the laws governing the macroscopic properties of a pure substance by covering fundamental concepts such as work, heat, and temperature. It is in this course that the student understands, describes, and quantifies the operation of thermodynamic machines such as engines, refrigerators, and heat pumps.

020TH2CI4 Thermodynamics 2 2 Cr.

This course enables students to master and apply the concepts and fundamental principles of thermodynamics. It aims to develop the ability to solve practical problems using energy, mass, and entropy balances. Indeed, energy in all its forms is studied in various machines, such as internal combustion engines, turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems, which require a command of powerful tools (Laplacian, divergence) in concrete situations. Students will become familiar with partial differential equations and learn to manipulate the famous heat diffusion equation with or without a source term in Cartesian, cylindrical, or spherical geometry.
Prerequisite: Thermodynamics 1 (020TH1CI2).

064VALEL1 USJ Values in Daily Life 2 Cr.

This course aims to raise students' awareness of the fundamental values of the Saint Joseph University of Beirut (USJ) in order to apply them in their personal, interpersonal, and professional lives. It engages them in critical reflection on how the values outlined in the USJ Charter can influence their behaviors, actions, and decisions to meet the challenges of the contemporary world. They will also be aware of global issues and ethical responsibilities, ready to contribute positively to the construction of a better society.

020OPTCI3 Wave Optics 2 Cr.

This course covers the key concepts of the wave theory of light. It begins with the definition of spherical and plane waves, accompanied by a comprehensive exploration of key principles associated with them, such as optical path length, wave intensity, wavefront, wave trains, and coherence length. Special attention is given to light interference through wavefront division (Young's double-slit experiment) and through amplitude division (Michelson interferometer). The impact of extended and narrow-spectrum light sources is also examined. Furthermore, an analysis of the Fraunhofer diffraction phenomenon is presented, followed by a study of interference generated by multiple coherent waves and the use of a diffraction grating.
Prerequisite: Physical Signals (020SPHCI1).

Regular Preparatory Chemical and Petrochemical Engineering

020AA1NI2 Analysis 1 4 Cr.

This course aims to develop a deep understanding of fundamental concepts in mathematical analysis and equip students with the ability to apply these tools to solve more advanced mathematical problems. It covers topics such as Taylor series expansions for approximating functions and studying their local behavior around a point. Students will also learn about anti-derivatives and improper integrals, gaining the skills to manipulate them effectively. Additionally, the course delves into the convergence or divergence of numerical series, teaching students how to determine convergence using specific criteria. Overall, these topics prepare students to tackle complex mathematical problem-solving tasks.

020AN2NI4 Analysis 2 6 Cr.

This course aims to deepen the understanding of advanced concepts in mathematical analysis. It covers various areas, such as the pointwise and uniform convergence of sequences and series of functions. Additionally, it provides a detailed exploration of power series, studying their radii of convergence, properties, and their relation to analytic functions. Complex analysis is also introduced, offering a study of functions of a complex variable, which holds great importance in various applications of engineering. Finally, the course addresses Fourier series, which are used to represent periodic functions through linear combinations of sine and cosine functions. This in-depth knowledge prepares students to engage with more advanced concepts in applied mathematics, physics, engineering, and other related disciplines.
Prerequisite: Analysis 1 (020AA1NI2).

020ATONI2 Atomic Structure and Chemical Bonding 2 Cr.

This course begins with a history of atomic sciences. It allows students to master the emission and absorption spectra concepts. Then the hydrogenoids (atoms with one electron) are explained before the polyelectronic atoms. A basis on bonding in isolated molecules – Simple Theories (Lewis + VSEPR) is covered. In the last part ionic and covalent bonds, molecular interactions and the periodic table are explained in detail. After each part is covered, tutorials are given to master the concepts and the know-how to apply them and make the necessary calculations.

020ALBNI3 Bilinear Algebra and Geometry 6 Cr.

This course provides students with a solid understanding of fundamental concepts, including the reduction of endomorphisms, pre-Hilbert spaces and endomorphisms of Euclidean spaces. Throughout this course, students will develop proficiency in techniques for reducing matrices and endomorphisms, along with their practical applications such as calculating matrix powers, solving linear recurrent sequence systems and utilizing linear recurrent sequences to compute the matrix exponential. Additionally, the course examines pre-Hilbert spaces, placing emphasis on key notions such as the inner product, orthogonality and orthogonal projections. Students will learn how to apply these concepts in solving problems related to orthonormalization. Furthermore, the course covers the study of planar isometries, encompassing translations, rotations and reflections, as well as isometries in space. By engaging with these topics, students will acquire a strong foundation in bilinear algebra and the necessary skills to apply these concepts effectively in practical situations.
Prerequisite: Linear Algebra (020ALNNI2).

020COANI4 Computer-Aided Design 4 Cr.

This course is intended for chemical and petrochemical engineering students who are using Aspen HYSYS® for the first time. It introduces them to process simulation and optimization and familiarizes them with the different features of HYSYS®. By the end of the lab, students should be capable of simulating basic chemical processes.

020CDFNI4 Differential Calculus 6 Cr.

This course is an in-depth exploration of differential equations and systems of ODEs. Fundamental concepts such as vector norms, subspaces, bases, and open and closed balls are thoroughly detailed. Then, students will explore the notions of convergence and equivalence between norms. The course also covers Topology by introducing fundamental concepts such as open and closed sets, adherent points, interior and boundary points. Then, a significant portion of the course is devoted to studying functions of several variables to explore concepts such as extrema and implicit functions. Finally, students will learn how to calculate double and triple integrals using various methods such as Cartesian, polar, and cylindrical coordinates. The concepts and techniques studied in this course are essential for developing advanced analytical skills and solving complex mathematical problems.
Prerequisite: General Analysis (020ANGNI1).

020MADNI1 Discrete Mathematics 6 Cr.

This course covers the following: Propositional logic - Mathematical reasoning - Sets - Relations - Natural numbers, induction - Applications - Algebraic calculation - Binomial coefficient and Pascal triangle - Polynomials – Arithmetic.

020GSCNI1 Engineering at the Service of the Community 2 Cr.

This course aims to explore the role of engineers in modern society, with a particular focus on innovation, renewable energies, green buildings, design, food security, recycling, and other areas relevant to our daily lives. Students will learn how engineers can leverage their technical skills, knowledge, and tools to address and solve social and environmental challenges through engineering.

020ANGNI1 General Analysis 6 Cr.

This course covers the fundamental concepts of analysis, including limits, continuity, differentiation, sequences, sets of numbers, and differential equations. Its objective is to equip students with the necessary skills to effectively calculate limits, perform differentiation and solve linear differential equations of both first and second order. In

addition, this course allows the development of mathematical reasoning skills. Students will learn to formulate coherent arguments, justify calculation steps and prove mathematical results. By the end of this course, students will have gained a solid foundation in analysis enabling them to pursue more advanced courses in mathematics, physics, and engineering.

020CHGNI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students will also learn the concept of heterogeneous equilibrium in an aqueous solution, the effect of the common ion and of complexation on solubility, complexation reactions and the influence of pH on solubility. Finally, this course allows students to analyze potential-pH diagrams through examples along vertical and horizontal lines.

020TCGNI2 General Chemistry Laboratory 2 Cr.

This course focuses on the comprehension of hazards and risks, as well as the identification of relevant safety guidelines. It aims to enhance students' knowledge regarding laboratory procedures, techniques, and safety protocols. Additionally, the course aims to develop students' skills in qualitative chemical analysis and titration of various mineral solutions, including acids, alkaline solutions, and precipitation reactions. Furthermore, students will learn to verify theoretical information through the determination of concentrations using electrochemical analysis methods such as spectrophotometric analysis. Emphasis will be placed on familiarizing students with the equipment used in each laboratory session and establishing a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGNI1).

020GELNI4 Geology 2 Cr.

This course aims to introduce fundamental concepts of geology. It focuses on structural geology, stratigraphy, and petrography. It covers brittle and ductile deformation and explains the behavior of materials under different kinds of stress, whether extensive or compressional. It also presents the different types of rocks, their genesis contexts, their physical properties and their organoleptic classification.

020CITNI4 Inorganic Chemistry and Laboratory 4 Cr.

This course allows students to acquire solid skills in the field of crystallography: compact and pseudo-compact stacking of metals, interstitial sites, metallic alloys, and metallic bonds. It also enables them to master basic notions on ionic solids through examples as well as on the solubility of a solid in binary systems through equilibrium diagrams. In addition, part of this course is dedicated to the study of the physical and chemical properties of certain chemical elements. This course is supplemented by laboratory work on the preparation of double salts and hydrogen peroxide, the determination of water hardness and the purification of calcium carbonate.

020IMFNI4 Introduction to Fluid Mechanics 2 Cr.

This course covers the following: Fluid properties, Hydrostatic law, Pascal law, Archimedes law, hydrostatic force on plane and curved surfaces. Lines of flow, types of flow, velocity field and acceleration, continuity equation, equation of streamline, stream function, velocity potential function, circulation, vorticity, irrotational and rotational flow, compressible and incompressible flows, Lagrange and Euler description.

020PIINI4 Introduction to Engineering Projects 2 Cr.

This course aims to instill a sense of responsibility in students, akin to that of researchers and engineers, by introducing and cultivating their skills in the scientific research process. It also seeks to integrate scientific and technological research endeavors and facilitate the development of conceptual and tangible components that actively contribute to the continuous process of knowledge creation, spanning from ideation to design and, in some cases, realization.

020CIHNI4 Kinetics of Chemical Reactions 2 Cr.

This course allows students to determine the rate of a chemical reaction and to understand the impact of different kinetic factors (temperature, concentration of reactants, catalysis) on the rate of a reaction. Through examples of simple chemical reactions, students will be able to express the rate law of a chemical reaction and the evolution of the concentration of a reactant over time. The notions of global order of a chemical reaction and partial order of the reactants are discussed, as well as the methods for determining the value of these orders. In addition, in the case of more complex reactions occurring in several steps, students will be able to apply the steady state theory in order to express the rate of a complex reaction, the rate of disappearance of a reactant or the rate of formation of a product.

020ALNNI2 Linear Algebra 8 Cr.

This course enables students to manipulate complex numbers and explore their properties to perform calculations and solve equations. They will develop an understanding of geometric transformations such as translations, rotations and homothety. This course introduces students to vector spaces and helps them understand concepts like linear independence, basis, and dimension. Linear transformations and matrices play a central role in this course. Students will examine the properties of linear transformations by learning how to find the kernel and image of these transformations and identify endomorphisms, automorphisms and isomorphisms. They will also learn to represent these transformations using matrices. Additionally, students will master the computation of determinants, which play a key role in the study of linear systems and their solutions. By acquiring this knowledge and these skills, students will be able to solve real-world problems and apply their knowledge in fields such as science, engineering, and computer science.

020MC1NI1 Mechanics 1 6 Cr.

This course studies particle mechanics, a branch of physics that analyzes the motion of objects as dimensionless mass points. This course simplifies physical systems by ignoring object dimensions and internal structure, focusing only on mass and position in space. This course applies Newton's laws to describe the relationship between applied forces, mass, and motion. This course enables students to analyze particle motion based on forces, mass, and initial conditions, providing a foundation for advanced concepts in classical mechanics, including kinematics, dynamics, laws of motion, and energy.

020MC2NI3 Mechanics 2 4 Cr.

This course studies solid mechanics, a branch of mechanics that examines the motion and equilibrium of objects considered as rigid bodies. This course covers the laws of mechanics for systems, focusing on solids, and shows how to determine the center of mass and study translational and rotational motion around a fixed axis. This course provides the definition of force systems and derived laws, allowing students to apply static, dynamic, and energetic principles to solve complex mechanical problems.
Prerequisite: Mechanics 1 (020MC1NI1).

020CORNI3 Organic Chemistry 4 Cr.

This course begins with an introduction to organic chemistry, the naming of organic molecules, and their spatial representation. It enables students to master stereoisomerism and the reactivity of molecules: inductive and mesomeric effects, nucleophilic and electrophilic reagents. Then, organic reactions are explained, and the following organic compounds are studied: halogenated derivatives – alkenes and alkynes – benzene and aromatic compounds – alcohols (substitution, elimination, oxidation) – carbonyl compounds (substitution on the acyl group) – reactions of aldehydes and ketones – carboxylic acids, esters, amides, and amines. After each part, tutorials are conducted to help students master the concepts.

020PCONI4 Organic Chemistry Laboratory 2 Cr.

This practical work allows students to master the methods of extraction, filtration, purification and synthesis of organic products. They will apply the theories explained in the course by concretizing the reactions of organic chemistry such as the extraction of caffeine from tea, the synthesis of aspirin, the synthesis of dibenzalacetone (aldol condensation), the Cannizaro reaction, the chromic oxidation of menthol and the preparation of the isoamyl

ester. In addition, column chromatography is explained.
Prerequisite: Organic Chemistry (020CORNI3).

020SPHNI1 Physical Signals 6 Cr.

This course enables students to understand the core principles pertaining to linear circuits and signal propagation. Throughout the course, students will delve into key concepts such as harmonic oscillators, progressive waves, interference, the fundamental laws of electrokinetics, complex notations, impedances and admittances, as well as linear filters. By the end of the course, students will possess the essential knowledge and skills required to effectively analyze and resolve challenges within these domains.

020PP1NI2 Physics Laboratory 1 2 Cr.

This practical work course is designed to bridge the gap between theoretical knowledge and practical application in the field of electrical engineering and physics. Throughout the course, students will engage in hands-on activities to gain a deeper understanding of various concepts. The key topics covered include resonance in RLC circuits, system analysis, circuit measurements, mechanics and motion, LabVIEW software, fields and characteristics, oscilloscope applications, single-degree-of-freedom oscillator, focal measurement, and optical systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts

020PRBNI4 Probability 4 Cr.

This course enables students to develop an understanding of the probability theory. It is designed to equip students with the necessary skills to effectively calculate probabilities. Throughout this course, students are introduced to various aspects of probability, beginning with combinatorics. They will learn techniques such as combinations, permutations and arrangements. Furthermore, they will explore concepts that enhance the understanding and manipulation of probabilities on a countable set. This includes the monotone convergence theorem, Boole's inequality, conditioning, compound probabilities, total probabilities and Bayes' formula. Additionally, the course emphasizes the study of discrete random variables, enabling students to model and analyze random phenomena using probability distributions. Finally, students will explore continuous random variables, with a focus on an extensive examination of cumulative distribution functions, expectation and variance.
Prerequisite: Analysis 1 (020AA1NI2).

020IF1NI2 Programming 1 4 Cr.

This course introduces the universal computer and the basic concepts of high-level programming using Python. Topics include: computer hardware components, algorithms, programming languages, Python and the IDLE environment, variables, arithmetic expressions and operators, primitive data types, data input and output, built-in composite data types, simple statements, control statements, logical expressions, relational and logical operators, function definition and call, functions from external modules.

020IF2NI3 Programming 2 4 Cr.

This course allows the students to acquire advanced concepts of structured programming in Python. It also covers the basic concepts of object-oriented programming and their application to data abstraction and encapsulation by introducing the concepts of object instantiation, member visibility, inheritance, and polymorphism. Students will also learn how to create an ergonomic standalone graphical user interface using the standard tkinter library.
Prerequisite: Programming 1 (020IF1NI2).

020CMTNI1 Supplemental Mathematics 2 Cr.

This course equips students with the necessary skills to solve elementary mathematical problems. They will learn key concepts such as composite and inverse functions, numerical sequences, circular functions, as well as definite and indefinite integrals. By studying composite and inverse functions, students will comprehend the relationships

between different functions and learn to decompose and reconstruct more complex functions. Additionally, this course introduces numerical sequences, particularly arithmetic and geometric sequences. Another essential component of this course is the study of basic trigonometric functions: sine, cosine, and tangent. Finally, this course covers definite and indefinite integrals by exploring their properties, the technique of integration by parts, the substitution method, and a fundamental application: calculating areas.

020TH1NI2 Thermodynamics 1 4 Cr.

This course enables students to master the key concepts of thermodynamics. It begins with an introduction to the different states of matter and scales of study. It then explores the state of a thermodynamic system, equations of state, and internal energy. Transformations of a thermodynamic system and the first law of thermodynamics are also studied, with a focus on pressure forces and heat transfers. The second law of thermodynamics and the concept of entropy are introduced, along with their applications. The course also covers the thermodynamic study of phase transitions.

020TH2NI3 Thermodynamics 2 4 Cr.

This course enables students to master and apply the concepts and fundamental principles of thermodynamics. Indeed, energy in all its forms is studied in various machines, such as turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems. Students will become familiar with partial differential equations and learn to manipulate the famous heat diffusion equation with or without a source term in Cartesian or cylindrical geometry.
Prerequisite: Thermodynamics 1 (020TH1NI2).

064VALEL1 USJ Values in Daily Life 2 Cr.

This course aims to raise students' awareness of the fundamental values of the Saint Joseph University of Beirut (USJ) in order to apply them in their personal, interpersonal, and professional lives. It engages them in critical reflection on how the values outlined in the USJ Charter can influence their behaviors, actions, and decisions to meet the challenges of the contemporary world. They will also be aware of global issues and ethical responsibilities, ready to contribute positively to the construction of a better society.

Bachelor of Engineering in Chemical and Petrochemical Engineering

435LALML2 Arabic Language and Arts 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop fundamental language skills while exploring a variety of cultural themes.
Specific objectives:
- Explore the diversity of Arabic artistic expressions.
- Understand the role of art in Arab culture and identity.

435LALAL2 Arabic Language and Media 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop fundamental language skills while exploring a variety of cultural themes.
Specific objectives:
- Understand the Arab media landscape and analyze its role in contemporary society.
- Develop critical media analysis skills in Arabic.

435LRCTL2 Arabic Language: Contemporary Novel, Cinema, and Theater 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop fundamental language skills while exploring a variety of cultural themes.
Specific objectives:
- Deepen knowledge of major Arabic literary and cinematic works.
- Develop critical thinking and debate skills in Arabic.

020TBICS5 Biochemical Techniques and Instrumentation 4 Cr.

This course covers the following: General principle of chemical and physical quantification. Comparison of different methods for identification and quantification of biomolecules. Electrochemical principle of biomolecule quantification and separation. Electrochemical instruments. Spectrophotometric methods and instruments in quantitative analysis. Chromatographic principles of separation, identification, and quantitative analysis. Chromatographic instruments.

020DROCS2 Business Law 2 Cr.

This course covers the following: Introduction to law, rules, and sanctions. Subjective rights. The trial, first instance, avenues of appeal (in civil and commercial matters). Commercial law: commercial acts, traders, goodwill. Commercial companies. Legal framework of the company's legal environment. Main payment and credit tools. Guarantees given and received by the company.

020CCHCS1 Chemical Kinetics/Heterogeneous Catalysis 2 Cr.

This course covers the following: Reactions in open and closed sequences. Basic concepts of catalysis and heterogeneous kinetics. Different stages of catalytic action (diffusion, adsorption, and surface reaction). Properties of solid catalysts and their main industrial and environmental applications.
Prerequisite: Kinetics of Chemical Reactions (020CIHNI4).

020THCCS1 Chemical Thermodynamics 4 Cr.

This course introduces the fundamental and advanced concepts of phase equilibria in chemical systems. The topics covered include ideal and non-ideal binary mixtures, Raoult's and Henry's laws, the phase rule, thermodynamic stability, and models for regular and modified regular solutions. The course explores phase envelopes, fugacity, and activity coefficients, as well as their application in modeling liquid–liquid equilibria (LLE) and vapor–liquid equilibria (VLE). Students will study cubic equations of state such as Peng–Robinson (PR), PRSV, and Soave–Redlich–Kwong (SRK), and learn how to use them to predict phase behavior. Practical applications include fractional distillation, separation of azeotropic mixtures, and eutectic systems.
Prerequisite: Thermodynamics II (020TH2NI3).

020CHPCS1 Chemistry of Polymers 4 Cr.

This course covers the following: Chapter I – Introduction – Definition of polymers, nomenclature, and classifications. Chapter II - Concepts of macromolecules: linkage of units, tacticity, and macromolecular masses. Chapter III - Reactions and polymerization techniques: step polymerizations - chain polymerizations. Chapter IV – Polymers and cohesion of macromolecular systems. Chapter V - Morphology in the condensed state. Chapter VI - Phase transitions. Chapter VII - Special structures. Chapter VIII - Thermomechanical properties of polymers. Chapter IX - Additives and adjuvants in polymers. Chapter X - Polymer transformation processes.
Prerequisite: Organic Chemistry (020CORNI3).

020COMCS2 Communication Skills 2 Cr.

This course emphasizes the importance of communication for engineering students. This course explains that transmitting information is essential in academic and professional activities for convincing and influencing others. This course highlights common errors and risks that can distort or mislead the reception of information. This course provides students with essential rules for written, verbal, and non-verbal communication and raises awareness of mistakes to avoid.

020MACCS5 Composite Materials 4 Cr.

This course explores the fundamental principles of composite materials, covering their classification, fabrication, characterization, micromechanics, and macromechanics. Non-conventional composites are also addressed.
Prerequisites: Inorganic Chemistry and Laboratory (020CITNI4) - Chemistry of Polymers (020CHPCS1).

020CONCS4 Contactors: Systems G-L, F-S, L-L 4 Cr.

This course covers the design, sizing, and application of gas-liquid (G-L), liquid-liquid (L-L), and fluid-solid (F-S) contactors in industrial processes. It includes both G-L and L-L separation technologies, such as tray and packed columns, countercurrent flow systems, and the selection criteria for various contactor devices. The course also explores fluid dynamics, characterization of solids, and hydrodynamic regimes in fixed and fluidized beds, with a focus on industrial applications and heat transfer mechanisms. Students will gain practical insights into the advantages, disadvantages, and technological considerations for each type of contactor system. Practical work.
Prerequisite: Mass Transfer (020PDTCS2).

020TCOCS5 Cosmetic Technology 4 Cr.

This course introduces students to the scientific, technological, and regulatory foundations of the cosmetic and cosmeceutical industry. Topics include the history and scope of cosmetology, the anatomy and physiology of the skin, and the distinction between traditional cosmetics and biologically active cosmeceuticals. Students will explore the raw materials used in cosmetic formulations, principles of product development and stability, ethical and environmental considerations, and current industry production technologies. Emphasis is placed on formulation strategies tailored to different skin types, the evaluation of product efficacy and safety, and regulatory compliance. Through case studies and practical insights, students will gain a comprehensive understanding of the cosmetic product lifecycle from concept to commercialization.

020CRPCS5 Design and Construction of Wells 4 Cr.

This course is the second course in oil and gas well drilling that students take. A basic knowledge of drilling rigs, onshore and offshore, and the drilling rig components is needed. This course focuses on the construction of a well from the beginning where the cellar is prepared, the rig is located, drilling the consecutive holes, running casing and cementing it, buildup of the wellheads, and all the processes involved within these major steps. Processes such as bottom hole equipment, drilling fluids, tubular goods, directional and horizontal drilling, processes that ensure successful reaching of TD (Total Depth), and understanding the drilling challenges that may be encountered during the well construction process.
Prerequisite: Drilling Technology (020TDFCS3).

020DTECS5 Digital Technologies Applied to Chemical Engineering 4 Cr.

This course delves into the application of digital technologies in chemical engineering, focusing on the integration of computational tools and data-driven approaches to enhance process design, optimization, and control. Students will explore the use of machine learning, artificial intelligence, and smart sensors in modeling complex chemical processes, predictive maintenance, and real-time process monitoring. The curriculum emphasizes the development and application of digital twins, process simulation, and automation technologies to improve efficiency and sustainability in chemical engineering practices. Through case studies and practical applications, students will gain hands-on experience in leveraging digital solutions to address contemporary challenges in the chemical industry.

020TDFCS3 Drilling Technology 4 Cr.

This course covers the theoretical and practical methods of calculation and operation of drilling equipment and their systems: electrical systems, fluid systems, lifting and rotation systems, control systems, drill string and drill bits, casing and cementing systems.
Prerequisite: Geology (020GELNI4).

020DCPCS3 Dynamics and Process Control 4 Cr.

This course includes the following: Introduction to process control: characteristics and associated problems. Dynamic modeling of chemical processes. Laplace transform and solutions of differential equations. Transfer function and dynamic behavior of first and second-order systems. Closed-loop control. Basic principles and new techniques related to the dynamics of continuous, batch, and hybrid processes. Development of a methodology in modeling (development and structuring of models) and dynamic process simulation based on algebraic-differential processing with extensions for parameter identification, constraint-based simulation, and optimization.
Prerequisite: Introduction to Continuous and discontinuous Processes (020PROCS2).

020GEACS5 Energy Management Applied to Processes and Utilities 2 Cr.

This course covers the following: Global energy balances. Energy balances on an industrial site. Different uses of energy. General presentation of utilities and typical processes. Energy efficiency. Energy saving potential. Reminders on heat exchange laws. Heat exchanger design method (thermal calculations and pressure loss calculations). Air-cooled and condenser technology. Cold production in industry, components (theoretical and real cycle, COP and Carnot efficiency). Industrial combustion. Boiler technology and operation (calculation of energy efficiency, economical steam production, flue gas recovery, air heater, economizer). Waste heat recovery (valorization by heat pump, by local electricity production via an ORC). Techno-economic aspect (case study).

020ANGCS4 English 4 Cr.

This course is designed to develop critical thinking, reading, oral and writing skills. It focuses on synthesizing sources producing a research paper and defending it in front of an audience. Emphasis is on the analytical reading of different text types required in the disciplines as well as on synthesis from a variety of sources to produce a written text and present it orally.

020ENPCS4 Entrepreneurship 2 Cr.

This course explores whether students should become entrepreneurs and the skills entrepreneurs need. This course examines entrepreneurship in a market economy and guides students in selecting a type of ownership. This course covers developing a business plan, identifying and addressing a market need, financing, protecting, and insuring a business. This course addresses choosing a location, starting a business, marketing, hiring and managing personnel, record keeping, accounting, and financial management. This course explains using technology and fulfilling legal, ethical, and social obligations.

020ETHCS1 Engineering Ethics 4 Cr.

The course is aimed at students wishing to work in public or private companies and in all fields. The objective of the course is to raise awareness of the necessity of ethics, which has become essential today, given current trends in sustainable development, dissemination of information to stakeholders, and transparent competition. The course offers future engineers the opportunity to analytically understand business issues and to distinguish themselves through their professionalism and enlightened attitude towards ethics. Finally, students will be more attentive to entrepreneurial approaches and the ethical reflection that accompanies them.

020BRFCS5 Fermentation Processes 2 Cr.

This course covers the following: Methods of microbiology. Microbial growth: analysis. Microbial growth: kinetic analysis. Growth and production reactions. Microbial growth: methods for biomass measurement. Microbial cell:

structure and function (schema). Kinetic analysis of fermentation. Overview of metabolism (nutrition; substrates and products). Major metabolic pathways. Microbial processes: kinetic laws, kinetics of industrial processes. Modeling of fermentation processes: physiological models, industrial fermentation.

020MEFCS2 Fluid Mechanics 4 Cr.

This course provides an in-depth understanding of fluid mechanics principles and their applications in chemical and petrochemical engineering. Students will explore the fundamental concepts of fluid behavior, fluid statics, fluid dynamics, and the practical aspects of fluid flow in industrial processes. The course emphasizes the analysis and design of fluid systems, including the fundamental elements for understanding incompressible fluid flow using the principles of mass, momentum, and energy conservation and resolution of the characteristic fluid flow equations through the application of analytical and analogous methods.
Prerequisite: Introduction to Fluid Mechanics (020IMFNI4).

020MFECS6 Final Year Project 16 Cr.

The final year project is carried out in groups of 2 to 3 students aiming to design an industrial unit, following a feasibility study and a selection among process alternatives. Students must develop the process scheme, calculate mass and energy balances, choose and size major equipment components, determine process startup, shutdown, and control conditions, conduct environmental and safety assessments, and an economic evaluation of the design. A final report and two oral presentations are the main project deliverables.
Prerequisite: Process Design Project (020PDPCS4).

020FEACS5 Food Manufacturing and Packaging 4 Cr.

This course provides a comprehensive understanding of food packaging materials and processes. Students will explore the role of ingredients, learn about advanced techniques such as microencapsulation and texturization, and gain insights into various packaging materials and their manufacturing processes. Topics include lamination, coating, aseptic packaging, and considerations of permeability. By the end of the course, students will have a solid foundation in food packaging, preparing them to make informed decisions in the industry.

020PFOCS5 Formulation Processes 2 Cr.

This course covers the following: Basic concepts and principles governing various colloidal environments. Physicochemical factors that can be manipulated (pH, temperature, salinity, addition of additives, etc.) to modulate the properties and behavior of these systems for desired applications. Applications in cosmetics and galenic formulations. Surfactants: 1) definition, 2) classification of surfactants, examples of industrial applications, 3) various surfactant structures, 4) surfactant character, 5) HLB concept. Aqueous surfactant solutions: 1) micelles, formation, definition of CMC and Nag (experimental determination, factors influencing CMC), direct micelle shapes and sizes, other aggregates. Microemulsions: 1) definition, phase diagram, parameters influencing formation and stability, Winsor regions. Emulsions, multiple emulsions: 1) formation, stability.

020RNICS2 Ideal and Non-Ideal Reactors 4 Cr.

This course covers the following: Material balances on ideal reactors: closed reactor, open stirred reactor, piston reactor. Energy balances in ideal reactors: closed reactor, open reactor in steady state. Real flows in reactors. Residence time distribution. Measurement of RTD: tracer method. Diagnosis of reactor malfunction. Modeling of non-ideal reactors: cascade of perfectly mixed tanks model. Axial dispersion model. Models with adjustable parameters set to zero. Practical Work.
Prerequisites: Kinetics of Chemical Reactions (020CIHNI4); Mass and Energy Balances (020BMECS1).

020CHICS2 Industrial Chemistry 4 Cr.

This course includes the following: Introduction to industrial engineering, through a comparative study of processes in inorganic chemistry and organic chemistry: This course allows students to analyze a process diagram

and, conversely, to design a block diagram based on the description of the process. This course teaches students the design of the first flow sheet of a process based on its description, the choice of technology (reactor, separations), the positioning of recycling, purges, the production chain, the industry economy interaction etc. The course ultimately provides some elements on the safety aspects and the environmental impact of the processes.

020PROCS2 Introduction to Continuous and Discontinuous Processes 4 Cr.

This course includes the following: Introduction: difference between continuous, batch, multi-product, multifunctional processes. Transient regime balances. Dynamics of continuous and batch processes. Application to reactors. Gantt chart. Description of design, planning, and scheduling problems of batch workshops: presentation of different criteria. Short-term planning: concept of recipe, representation of recipes (SSN STN), associated mathematical model, and optimization. Simulation of batch processes.

020BMECS1 Mass and Energy Balances 6 Cr.

This course covers the following: Unit operations and degree of freedom analysis. Material balances on unit processes. Calculations on multi-unit processes. Material balances in processes with reaction. Multiple systems with reaction, recycling, and purging. Energy balances in the absence of reaction. Energy balances with reaction; Material and energy balances under transient conditions.
Prerequisite: Thermodynamics II (020TH2NI3).

020PDTCS2 Mass Transfer 4 Cr.

This course covers the following: Identification of mass transfer mechanisms. Formulation of rate equations. Estimation of diffusion coefficients for binary gas and liquid phase systems. Determination of molar fluxes for steady-state diffusion of A through stagnant B and for equimolar counter-diffusion. Calculation of fluxes through porous solids for both types of diffusion: molecular and Knudsen. Explanation of mass transfer coefficient concept for turbulent diffusion by analogy with molecular diffusion. Calculation of interfacial mass transfer rates as a function of local mass. Definition and use of overall mass transfer coefficients. Definition and generation of minimum and actual operating curves for co-current and counter-current processes in steady state.

020TMCCS4 Mathematical Techniques in Chemical Engineering 6 Cr.

This course covers the following: Review of fundamental properties used in optimization. Optimization problem (mathematical programming). Derivation. Notion of topology. Convexity. Convexity analysis. Eigenvalues. One-dimensional search. Definitions and general assumptions. Method of direct search for the golden ratio. Quadratic interpolation method (quasi-Newton). Examples. Conclusion. Theoretical aspects of unconstrained optimization. Problem formulation. Fundamental theorem. Conclusion. Numerical methods for unconstrained problems. Fundamental principle of descent methods. Descent direction. Step length. Termination test(s). First-order methods. Second-order Newton method. Quasi-Newton methods. Generalized reduced gradient, SQP.
Prerequisite: Dynamics and Process Control (020DCPCS3).

020AMTCS4 Mechanical Agitation and Transfer 2 Cr.

This course focuses on mechanical agitation and mass transfer principles in bioreactors, with an in-depth exploration of stirred aerated reactors. Key topics include the hydrodynamic constraints in mechanical mixing, the impact of agitation on transfer rates, and the modeling and extrapolation of fermentation processes. Students will gain a comprehensive understanding of how mechanical agitation influences bioreactor performance and the overall efficiency of fermentation.
Prerequisite: Mass Transfer (020PDTCS2).

020MCECS3 Microbiology - Enzymatic Catalysis 4 Cr.

This course covers the following: Introduction and history. Ultrastructure and morphology. Bacterial systematics. Growth and physiology. Bacteria/host relationship. Bacterial genetics. Antibiotics/antiseptics. Introduction: nucleic acid structure, restriction enzymes. Different types of RNA. Transcription in eukaryotes and prokaryotes. Post-transcriptional modifications in eukaryotes and prokaryotes. Transcriptional regulation. Ribozymes. Genetic

code and translation in eukaryotes and prokaryotes. Post-translational modifications. Replication. Sequencing. Different molecular biology tools. Introduction to biotechnology. Enzymatic processes: kinetic laws, trends in industrial enzymology, models of starch hydrolysis processes. Processes with immobilized enzymes and cells: immobilized enzyme technology, fixed cell technology.

020MOSCS3 Modeling and Simulation 2 Cr.

This course is designed for chemical engineering students who have already been exposed to Aspen HYSYS®. It aims to deepen their understanding of process simulation while introducing them to some new features of HYSYS®. Throughout the sessions, students will enhance their ability to simulate more complex chemical processes, building on the knowledge gained in a previous course.
Prerequisite: Computer-Aided Design (020COANI4).

020ANNCS1 Numerical Analysis 4 Cr.

This course covers the following: General introduction to numerical methods. Approximation and interpolation. Numerical integration. Numerical differentiation. Numerical solution of differential equations. Systems of linear equations. Nonlinear equations and systems of nonlinear equations. Methods for computing eigenvalues. Partial differential equations.
Prerequisites: Analysis II (020AN2NI4), Bilinear Algebra and Geometry (020ALBNI3).

020PPCCS4 Petrochemical Processes 4 Cr.

This course includes the following: Introduction to chemical process industries. Raw materials for organic chemical industries. Profile of the petrochemical industry and its structure. Raw materials: existing and emerging. Overview of unit processes with applications, Nitration-nitrobenzene, nitrotoluenes, Halogenation-DCM, MCA, VCM, chlorobenzene. Esterification - Alcohols C1 to C4. Production of olefins and derivatives, naphtha and gas cracking for olefins production. Recovery of chemicals from FCC and steam cracking. Ethylene derivatives: ethylene oxide, ethylene glycol, vinyl chloride, propylene, and propylene oxide. Aromatic production, separation of aromatics. Aromatic product profile - Benzene, toluene, xylene, ethylbenzene and styrene, cumene and phenol, bisphenol, aniline unit - Polymers V and elastomers. Polymers: polyethylene, polypropylene, polystyrene, polyvinyl chloride, polycarbonate, thermosetting resin: phenol-formaldehyde, urea-formaldehyde, and melamine-formaldehyde. Elastomers: styrene butadiene (SBR), polybutadiene, nitrile rubber unit - VI fibers. Polyamides or nylons (PA), DMT and terephthalic acid, polyester, acrylic fiber, modified acrylic fiber, acrylonitrile, acrolein, viscose and acetate fiber.
Prerequisite: Refining Processes (020PRPCS3).

020CPPCS3 Pharmaceutical Process Design 4 Cr.

This course includes the following: Introduction to synthesis, separation, and sterile processing and their applications to the design and optimization of pharmaceutical processes. Fundamental principles of drug synthesis. Industrial pharmaceutical examples. Introduction to essential operations used in the manufacture of pharmaceutical products. Separation process, distillation, crystallization, filtration, lyophilization, and drying. Lifecycle of pharmaceutical products, variability, testing, and specifications of pharmaceutical ingredients. Unit operations, including mixing, granulation, fluid bed operations, milling, capsule filling, compression, tablet coating, scaling up, troubleshooting, and optimization.

020PRPCS5 Petroleum Production 4 Cr.

This course covers the theoretical and practical methods of calculations and operations of petroleum production: Production from undersaturated, two-phase and NG oil reservoirs; Wellbore Flow Performance and deliverability; Forecast of well production; Artificial lift; Well stimulation techniques.
Prerequisite: Drilling Technology (020TDFCS3).

020CEPCS4 Process Equipment Design 4 Cr.

This course covers the following: General design procedure. Design methodology. Stages of the design activity. Process design and mechanical design. Mechanical properties of materials. Safety factor. Construction material. Selection. Economic considerations in the design process. Design of basic machine elements (shafts, keys, and belts). Design of mechanical components such as protected and unprotected flange couplings. A brief overview of process design aspects of pressure vessels (such as a reactor for example), head design (flat, hemispherical, torispherical, elliptical, and conical). Design of storage tanks. Study of different types of storage tanks and applications. Atmospheric vessels, vessels for storing volatile and non-volatile liquids. Gas storage. Losses in storage vessels. Various types of roofs. Types of heat exchangers. Codes and standards for heat exchangers. Design of heat exchanger (U-tube and fixed-tube), i.e., shell, head, tubes. Fouling in heat exchangers. Types of fouling. Safety measures and overprotection devices in equipment design. Risk analysis in equipment design, overpressure protection devices such as blowdown, relief valves, rupture disk, steam purge system, etc.

020PDPCS4 Process Design Project 6 Cr.

This project enables students to apply their knowledge in a process context. Teams of 2 to 4 students will work on creating or modifying a flowsheet for the manufacture of a desired chemical product.
Prerequisites: Modeling and Simulation (020MOSCS3)- Pre or Co-requisite: Process Equipment Design (020CEPCS4).

020GEPCS4 Production Management 2 Cr.

This course covers the following: Introduction to the main methods of managing production systems. Design system (study office, methods, industrialization) and management system. Push/pull flow approach, business process (workflow), and production-related functions. Project/production differences. Technical data (bill of materials, routing, work center, lead times) and production data. Production planning (MRP, load/capacity adjustment, inventory management). Operational production management (scheduling, procurement). Production management (control/command, monitoring, launch, follow-up). Software solutions for production (APS, ERP, MES, supervisor, PLC).

020GEPCS5 Process Engineering Lab 2 Cr.

This course offers an exploration of four fundamental methods used in industry for the efficient separation of dissolved or suspended substances within complex mixtures. These techniques include liquid-liquid extraction, absorption, distillation and reverse osmosis. Through this laboratory course, students will have the opportunity to gain a concrete understanding of these processes and their applications, while enhancing their problem-solving skills through practical experiments and data collection.
Prerequisite: Separation Techniques (020TESCS3).

020IBDCS1 Programming and Databases 4 Cr.

This course presents the basics of object-oriented programming to develop applications including databases. It equips students with the skills needed in the field of object-oriented programming and databases and their implementation. This course is divided into several phases. Present the C# language and the fundamental concept of object-oriented programming. Present the fundamental concept of relational databases. Specify the fundamental concepts of setting up and using databases in the relational context. Query optimization, SQL, PL/SQL language, triggers, stored procedures, and views under Oracle, MySQL, or PHPMYSQL.
Prerequisite: Programming II (020IF2NI3).

020GPRCS5 Project Management 2 Cr.

This course introduces the fundamentals of project management, covering both organizational and technical aspects. Topics include the definition and phasing of a project, milestone structuring, and the roles and responsibilities of key stakeholders (sponsor, contractor, implementation team). The course emphasizes objective setting and project breakdown into deliverables, activities, costs, and responsibilities. Students will explore project planning approaches and methods, resource allocation strategies, and integrated cost control. Key financial concepts such as ROI, IRR, CAPEX, and OPEX will be introduced. Additional topics include deadline management, quality control, task evaluation at all project stages (before, during, and after), and the analysis of lessons learned.

020QHSCS2 Quality, Health, Safety 2 Cr.

This course covers the following: Risk classification. Chemical risks. CLP regulation. Hazard classes. Risks related to chemical product storage. Evaluation and prevention of chemical risks in the company. Fire risk. Emergency intervention planning. Engineers' contributions to risk management. Risk analysis methods.

020PRPCS3 Refining Processes 6 Cr.

This course covers the following: Physicochemical properties and standardized tests. Relationship between product specifications and their use (fuels and other products). Implementation of crude oils. Petroleum logistics. Strategic stocks. Petroleum distribution. Industrial catalysts. Catalytic reforming. Isomerization. HD. Catalytic cracking. VGO and residues, VGO and residue hydrocracking. Sulfur chain. Refinery internship. FCC gasoline treatment. Oligomerization, etherification, alkylation. Residue valorization. Visbreaking. Coking. Softening. Base oils, waxes, paraffins, bitumens. Gas: desulfurization, dehydration, liquid extraction from gases, and practical exercises. Natural gas liquefaction. Gas pipeline transportation. LNG transport terminals, Flow assurance. Synthetic gas: H2 production and Fischer Tropsch process, SMDS. Steam cracking. Aromatic loop. Selective hydrogenations. Ethylbenzene – Styrene, PEHP. Petroleum analysis lab.
Prerequisite: Organic Chemistry (020CORNI3).

020IDRCS5 Reservoir Engineering 4 Cr.

This course covers the following: Darcy's law and applications. Permeability concepts. Relative permeability. Capillary pressure. Wettability. Material balance equations for different types of reservoirs and drives. Aquifer behavior and water influx. Immiscible displacement. Buckley-Leverett theory. Stable displacement by gravity. Coning and cresting. Decline curve analysis. Reservoir and well deliverability.
Prerequisite: Geology (020GELNI4).

020TESCS3 Separation Techniques 6 Cr.

This course covers the following: Physical aspects of phenomena (definition, application). Equilibria, solutions, and solubility, solvent selection. Analysis by macroscopic balances: variance, balance, operating curve, and function diagram. Countercurrent absorption of a component: cut. Scope of the problem and assumptions. Algebraic resolution. Graphical treatment. Distillation of a binary mixture. McCabe and Thiele Method - Ponchon-Savarit Method - Incidence of operating conditions. Multicomponent distillation. Problem analysis - Short Cut Method (Fenske, Underwood, Gilliland, Kirkbridge Relation). Solvent selection, characteristics, and properties of solvents. Equilibria between liquid phases. Study of simple, multiple-contact, and countercurrent contactors with and without reflux. Understanding the mechanisms of liquid-solid separation and the fundamental equations for sizing industrial equipment for this separation. Decantation: theoretical study - limiting settling velocity. Experimental study. Modeling of continuous decanters with vertical walls. Sizing of continuous decanters with vertical walls. Filtration: definitions and ancillary techniques. Theory of filtration on support. Application examples. Membrane filtration: membrane separation techniques. Osmotic pressure. Polarization phenomenon. Mechanisms of fouling. Electrodialysis compartments. Centrifugation: centrifugal effect and centrifugal pressure of filtration. Centrifugal squeezing and flow rates.
Prerequisite: Chemical Thermodynamics (020THCCS1).

020GDSCS5 Solid and Hazardous Waste Management 4 Cr.

This course offers students a thorough understanding of core principles, waste generation methods, environmental and health impacts, and a range of management options including sanitary landfills, material recovery, energy recovery, waste minimization, thermal treatment, chemical/physical/biological treatment, site remediation, and waste sorting/recycling facilities. By examining current and future trends, students will be equipped to develop and implement effective strategies for reducing environmental effects, advancing circular economy practices, and contributing to global sustainability.

020ASCCS5 Statistical Analysis and Design of Pharmaceutical Operations 4 Cr.

The course introduces statistical analysis and experimental design methods and their applications in the design

and optimization of pharmaceutical processes. Classical statistical concepts and methods will be examined using pharmaceutical examples, including product/process development scenarios, routine testing during manufacturing, finished products, and failure investigations. Regulatory requirements for sample testing, sampling plans, tablet and capsule dosage, content uniformity, hardness, friability, dissolution, and bioavailability testing will be discussed in detail.
Prerequisite: Statistics (020STACS2).

020STACS2 Statistics 4 Cr.

This standard applied statistics course applies to the field of Engineering Sciences. It presents the statistical analyses necessary for a researcher in the field of chemical and petrochemical engineering. Topics to be covered include descriptive statistics, parametric tests (t-test for independent samples, paired samples t-test, one-sample t-test, ANOVA), non-parametric tests (Mann-Whitney test, Wilcoxon signed-rank test, Wilcoxon rank-sum test, Kruskal-Wallis test), chi-square test as well as correlation and linear regression. The course focuses on verifying the assumptions required by each statistical test used (normality, equality of variances, etc.). It uses the flipped classroom approach to expose students to a basic statistical method as well as the use of statistics in the real world. Finally, the course uses IBM-SPSS software for analyses.
Prerequisite: Probability (020PRBNI4).

020ST1CS3 Summer Internship I 2 Cr.

This internship, lasting 4 to 6 weeks, introduces students to the basic tools, safety practices, and workflows in chemical engineering settings. It aims to build familiarity with laboratory techniques, equipment, and industrial operations, while helping students begin to develop a professional mindset.

020ST2CS5 Summer Internship II 2 Cr.

This internship, lasting 6 to 8 weeks, provides students with in-depth experience in an industrial environment where they can apply their academic knowledge to real engineering problems. Students may be involved in process optimization, quality control, production supervision, safety assessments, or project engineering tasks, thereby preparing them for a professional career.

020CHTCS1 Theoretical Chemistry 4 Cr.

This course includes the following: Introduction to quantum phenomena, postulates of quantum mechanics: angular momentum, hydrogen atom. Major approximation methods: variational principle, perturbation theory. Multi-electron atom. Approximation of atomic orbitals. Approximation of molecular orbitals and quantum chemistry methods: Hartree-Fock, Hückel method. Application to diatomic and polyatomic molecules. Role of spatial symmetry. Introduction to reactivity. Approximation of frontier orbitals.
Prerequisite: Atomic Structure and Chemical Bonding (020ATONI2).

020GTHCS3 Thermal Engineering 4 Cr.

This course includes the following: Study of convection (natural convection: empirical relationships, forced convection in pipes, laminar regime - theoretical and empirical relationships, turbulent regime - empirical relationships, Extension to non-cylindrical pipes and film flows, forced convection around solid obstacles, case of cylinder and sphere, case of tube bundles, case of the shell of a multitubular exchanger). Heat exchanger theory (co-current, counter-current, and multi-pass approaches, definition and expression of overall heat transfer coefficient, DTML method, Efficiency method, practical sizing method: this part is essentially treated using the example of multitubular exchangers). Other heat transfer technologies (plate and spiral exchangers, transfer in agitated tanks). Phase change heat transfer (condensation of pure vapor, condensation of a vapor mixture). Practical Work.
Prerequisite: Thermodynamics II (020TH2NI3).

020STMCS2 Total Synthesis and Activation Methods 2 Cr.

This course covers the principles and methods of total synthesis, with a focus on industrial alternatives, synthesis planning, and retro synthesis techniques. Key topics include solutions to chemoselectivity issues, protection of functional groups, enantiomer splitting techniques, and asymmetric induction. Students will explore prediction of stereochemistry from diastereoselective reactions, asymmetric synthesis strategies, and enzymatic engineering for industrial applications. The course also touches on green chemistry principles, sustainable practices in synthetic processes, bioprocesses, and green alternatives to conventional solvents. Additionally, it introduces the principles and applications of electrosynthesis, sonochemistry, and microwave activation, with a focus on their advantages, limitations, and industrial-scale implications.
Prerequisite: Organic Chemistry (020CORNI3).

020MLTCS5 Tribology and Lubricants 4 Cr.

This course explores the study of tribology and lubricants, covering fundamental principles related to friction, wear, and lubrication. Additionally, the course explores topics such as lubricating base oils and their importance in technical applications.
Prerequisites: Refining Processes (020PRPCS3) - Fluid Mechanics (020MEFCS2).

020OPUCS3 Unit Operations: Adsorption, Drying, Crystallization 4 Cr.

This course covers the following: Designing adsorption columns. Mass transfer zone and breakthrough curve in a fixed-bed column. Empirical methods: unused bed length. Scaling approach. Mathematical models (Thomas model, Bohart-Adams model (bed depth service time, BDST), Yoon Nelson model). Drying. Dryer efficiency. Mass transfer in drying. Psychrometry. Equilibrium relative humidity. Drying rates. Calculation of drying times. Material and energy balance on a continuous dryer. Different types of dryers. Crystallization. Fundamentals of crystal growth. Measurement of growth rate. Crystal yield. Crystallization technologies. Equipment for solution crystallization. Crystallization in the molten state. Modeling and design of crystallizers. Lab work: 1-Drying 2-Crystallization
Prerequisite: Chemical Thermodynamics (020THCCS1).

020TEUCS5 Wastewater Treatment 4 Cr.

This course covers the following: Classification of wastewater from different perspectives. Assessment of wastewater pollution. Equipment of wastewater treatment plants. Technological lines for wastewater treatment and sludge disposal. Mechanical, chemical, and biological stages of wastewater treatment. Pretreatment and primary stage of wastewater treatment - mechanical separators, sedimentation and flotation, settler. Secondary stage of wastewater treatment - activation and secondary settler, basic parameters of activation, types of aerobic bioreactors, nitrification and denitrification, phosphorus removal. Tertiary stage of wastewater treatment - post-treatment of wastewater. Anaerobic processes - types of anaerobic bioreactors. Treatment of sewage sludge. Industrial wastewater treatment. Physico-chemical and chemical treatment processes. Modeling, design, and optimization of activated sludge process. An introduction to automatic control of wastewater treatment plants.

020WORCS4 Work Ready Now 2 Cr.

This course is designed to provide students with general skills, communication skills, and workplace learning experiences to prepare them for success in the workplace. It is designed to facilitate participatory and practical teaching and learning. Students will be actively engaged in the learning process and will have the opportunity to practice and enhance new skills and gain the self-confidence needed to obtain and maintain employment related to their career goals. Workplace learning activities are integrated into the course and require students to visit real workplaces in the profession outside of class hours. Students will be guided to use free online digital tools to demonstrate their learning. Throughout the course, students will create a career portfolio that will assist them in their Work Ready Now experimental journey from student to employee.