HONORS PREPARATORY IN INDUSTRIAL ENGINEERING

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campus Where the Program Is Offered: CST

OBJECTIVES

The objectives of the Industrial Engineering program are to equip students to:

- Advance in their careers in various sectors at local, regional, and international levels while respecting ethical and professional conducts.
- Successfully pursue higher education in world-class universities.
- Become decision-makers, innovators, and leaders in their profession.

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

- 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.

PROGRAM REQUIREMENTS

120 credits: Required courses (120 credits)
USJ General Education Program (10 credits, part of the required courses – *26 additional credits are earned at the Department of Electrical and Mechanical Engineering)*

USJ General Education Program (10 Cr.)
Humanities (4 Cr.)
Engineering at the Service of the Community (2 Cr.)
USJ Values (2 Cr.)
Quantitative Research Techniques (6 Cr.)
Discrete Mathematics (6 Cr.)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 Cr.): Algebra I (6 Cr.), Algebra II (6 Cr.), Algebra III (4 Cr.), Analysis I (4 Cr.), Analysis II (6 Cr.), Analysis III (4 Cr.), Discrete Mathematics (6 Cr.), General Analysis (6 Cr.).
Sciences (50 Cr.): Advanced General Chemistry (4 Cr.), Electromagnetism (4 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Magnetic Induction (2 Cr.), Mechanics I (6 Cr.), Mechanics II (4 Cr.), Physical Signals (6 Cr.), Physics Laboratory I (2 Cr.), Physics Laboratory II (2 Cr.), Quantum Physics (2 Cr.), Signal Processing (2 Cr.), Thermodynamics I (6 Cr.), Thermodynamics II (2 Cr.), Wave Optics (2 Cr.).
Programming (10 Cr.): Programming I (4 Cr.), Programming II (4 Cr.), Programming III (2 Cr.).

Engineering Fundamentals (10 Cr.): Digital Systems Design (4 Cr.), Linear Electrical Systems and Networks (4 Cr.), Supervised Personal Initiative Work (2 Cr.).
Humanities (8 Cr.): Engineering at the Service of the Community (2 Cr.), French and Philosophy I (2 Cr.), French and Philosophy II (2 Cr.), USJ Values (2 Cr.).

SUGGESTED STUDY PLAN

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics I	6
020SPHCI1	Physical Signals	6
	Total	**30**

Semester 2

Code	Course Name	Credits
020AL1CI2	Algebra I	6
020AA1CI2	Analysis I	4
020FR1CI2	French and Philosophy I	2
020TCGCI2	General Chemistry Laboratory	2
020INMCI2	Magnetic Induction	2
020PP1CI2	Physics Laboratory I	2
020IF1CI2	Programming I	4
020TH1CI2	Thermodynamics I	6
	Total	**28**

Semester 3

Code	Course Name	Credits
020CHACI3	Advanced General Chemistry	4
020AL2CI3	Algebra II	6
020AN2CI3	Analysis II	6
020EMECI3	Electromagnetism	4
020FR2CI3	French and Philosophy II	2
020MC2CI3	Mechanics II	4
020PP2CI3	Physics Laboratory II	2
020IF2CI3	Programming II	4
020TRSCI3	Signal Processing	2
020OPTCI3	Wave Optics	2
	Total	**36**

Semester 4

Code	Course Name	Credits
020AL3CI4	Algebra III	4
020AN3CI4	Analysis III	4
020TEDCI4	Digital Systems Design	4
020SRLCI4	Linear Electrical Systems and Networks	4
020IF3CI4	Programming III	2
020PHQCI4	Quantum Physics	2
020TIPCI4	Supervised Personal Initiative Work	2
020TH2CI4	Thermodynamics II	2
064VALEL1	USJ Values	2
	Total	**26**

COURSE DESCRIPTION

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide 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, 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, Uniform corrosion in an acidic or neutral oxygenated medium; Differential corrosion by heterogeneity of the support or the environment; Protection against corrosion.
Prerequisite: General Chemistry (020CHGCI1)

020AL1CI2 Algebra I 6 Cr.

Algebraic structures, vector spaces, linear applications, matrices, determinants, linear systems, Euclidean spaces.

020AL2CI3 Algebra II 6 Cr.

This course, a continuation of Algebra I, 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 equivalent matrices. With a mix of theoretical understanding and practical applications. Students will gain a comprehensive understanding of these mathematical concepts.
Prerequisite: Algebra I (020AL1CI2)

020AL3CI4 Algebra III 4 Cr.

Algebra III is an advanced course, 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 II, this course provides students with a comprehensive understanding of these mathematical disciplines.
Prerequisites: Algebra II (020AL2CI3) and Analysis I (020AA1CI2)

020AA1CI2 Analysis I 4 Cr.

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, finite random variables.

020AN2CI3 Analysis II 6 Cr.

Normed vector spaces: continuity, uniform continuity and Lipchitz 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, line integrals.
Prerequisite: Analysis I (020AA1CI2)

020AN3CI4 Analysis III 4 Cr.

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

020DISCI4 Computer Assisted Drawing 2 Cr.

Drawing on AutoCAD. Classification of drawings. Standardization. Presentation of drawings. Methods of executing a drawing. Geometric constructions. Connections. Common curves. Presentation of solids. Dimensioning. Cross-sections. Sections. Surface states. Tolerances and fits. Functional dimensioning. Assembly drawing. Modes of mechanical connections. Means of mechanical connections and technological elements. Symbolic representation.

020TEDCI4 Digital Systems Design 4 Cr.

This course provides students with the opportunity to familiarize themselves with various methods of designing simple digital systems. They will learn how to decompose a function into combinational and sequential blocks, and discover techniques for automating industrial processes based on specifications. The course content covers essential concepts such as number systems and codes, combinational and sequential logic, logical functions, and integrated logic circuits. Students will also explore topics including the Morgan's theorem, Karnaugh maps, flip-flops, synchronous and asynchronous binary counters/decoders, and shift registers. Practical work will be conducted to apply these concepts.

020MADCI1 Discrete Mathematics 6 Cr.

Logic and reasoning, Set theory, Applications, Binary relations, Algebraic calculations, Complex numbers, Integer arithmetic, Polynomials.

020EMECI3 Electromagnetism 4 Cr.

This course starts with a separate study in 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 equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is shifted to the propagation of EM waves in vacuum, in conductors, in plasma and far away form an EM oscillating dipole.
Prerequisites: Physical Signals (020SPHCI1) and 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 I 2 Cr.

This course prepares first-year students for the written French entrance exam at École Polytechnique (Filière Universitaire Internationale - Formation Francophone, FUI-FF). Its objective is to provide students with the academic and didactic tools necessary for success in this entrance exam.

020FR2CI3 French and Philosophy II 2 Cr.

This course prepares second-year students for the written French entrance exam at École Polytechnique (Filière Universitaire Internationale - Formation Francophone, FUI-FF). Its objective is to provide students with the academic and didactic tools necessary for success in this entrance exam.

020ANGCI1 General Analysis 6 Cr.

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, Roll's Theorem, 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 also learn the concept of heterogeneous equilibrium in an aqueous solution, the effect of the common ion and complexation on solubility, complexation reactions and the influence of pH on solubility. Finally, this course allows the analysis of 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. 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 (020CHGCI1)

020GELCI4 Geology 2 Cr.

This course aims to introduce fundamental concepts of geology. It focuses on the 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, whether extensive or compressional. It also presents the different types of rocks, their genesis context, 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 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 will be 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.

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.

020SRLCI4 Linear Electrical Systems and Networks 4 Cr.

This course serves as an introduction to the fundamental principles of electrical engineering, focusing on the analysis of electric circuits. Students will delve into resistive network analysis, AC network analysis, transient analysis, and explore frequency response and system concepts. The use of Bode, Black, and Nyquist diagrams will be extensively covered to provide a comprehensive understanding of electrical circuits.
Prerequisite: Physical Signals (020SPHCI1)

020INMCI2 Magnetic Induction 2 Cr.

This course is new to students since they only had a descriptive approach to the magnetic field in high school. It is concerned with everyday applications: compass, electric motor, alternator, transformer, speaker, induction plate, radio frequency identification, etc. Magnetic flux is introduced, and magnetic dipole of a current circuit is generalized to magnet.

020MC1CI1 Mechanics I 6 Cr.

The main objective of this course is to master the principles and fundamental concepts of classical physics (inertia principle, fundamental principle of dynamics, principle of reciprocal actions, work-energy theorem), and to enhance the 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 II 4 Cr.

The Mechanics II 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 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 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, the Mechanics II 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 I (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 in high school: periodic signals, spectrums, electrical energy, Ohm's law, Joule's law, lenses, wavelength, light spectrum, numerical signal, traveling 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 in high school.

020PP1CI2 Physics Laboratory I 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, focometry 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 II 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 pulsograph (oscillator with two degrees of freedom), diffraction and interference, as well as polarization.
Prerequisite: Physics Laboratory I (020PP1CI2)

020IF1CI2 Programming I 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 II 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 I (020IF1CI2)

020IF3CI4 Programming III 2 Cr.

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 programing – recursive structures (lists, trees) – LIFO – FIFO – complexity – graph – propositional logic – deterministic and non-deterministic finite state automata – regular expressions.
Prerequisite: Programming I (020IF1CI2)

020PHQCI4 Quantum Physics 2 Cr.

This course is concerned with two aspects of modern physics. The first based on the Schrodinger formulation of the wave mechanics and is treat simple but fundamental problems: free particle, particle in a single-step potential, tunnel effect, particle in a box and energy quantification. 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 discreet 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 will be 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)

020STACI4 Statics 2 Cr.

Statics is an introduction to learning and applying the principles required to solve engineering problems. Concepts will be applied in this course from previous courses taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. The purpose of this course is to study methods for quantifying the forces between bodies and defining their equilibrium. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Motion and changes in shape are critical to the functionality of objects and structure. Statics is an essential prerequisite for many branches of engineering, such as civil engineering and mechanical engineering, which address the various consequences of forces.
Prerequisite: Mechanics I (020MC1CI1)

020STMCI4 Statics for Mechanical Engineering 2 Cr.

Statics is an introduction to learning and applying the principles required to solve engineering problems. Concepts will be applied in this course from previous courses taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. The purpose of this course is to study methods for quantifying the forces between bodies and defining their equilibrium. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Motion and changes in shape are critical to the functionality of objects and structure. Statics is an essential prerequisite for many branches of engineering, such as civil engineering and mechanical engineering, which address the various consequences of forces.
Prerequisite: Mechanics I (020MC1CI1)

020TIPCI4 Supervised Personal Initiative Work 2 Cr.

In this course students 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.
The student's work revolves around concrete research, analyzing reality to 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 I 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 students understand, describe, and quantify the operation of thermodynamic machines such as engines, refrigerators, and heat pumps.

020TH2CI4 Thermodynamics II 2 Cr.

The objective of this course is 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 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 I (020TH1CI2)

020TOGCI4 Topography 2 Cr.

The objective of this course is to introduce surveying, covering topics such as geodesy and cartography, levelling, the use of measuring instruments, creation of topographic plans, profiles, and volume calculations, setting out techniques, and preparation of surveying base plans and official document folders.

064VALEL1 USJ Values 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 diffraction grating.
Prerequisite: Physical Signals (020SPHCI1)