BACHELOR OF ENGINEERING IN INDUSTRIAL 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 Industrial Engineering
The Industrial Engineering program enables students to:
- Advance in their careers in various sectors at local, regional, and international levels while respecting ethical and professional conduct.
- Successfully pursue higher education in world-class universities.
- Become decision-makers, innovators, and leaders in their profession.

Objectives – Regular Preparatory Industrial Engineering
The Industrial Engineering program enables students to:
- Advance in their careers in various sectors at local, regional, and international levels while respecting ethical and professional conduct.
- Successfully pursue higher education in world-class universities.
- Become decision-makers, innovators, and leaders in their profession.

Objectives – Bachelor of Engineering in Industrial Engineering
The Bachelor of Engineering in Industrial Engineering enables students to:
- Advance in their careers in various sectors at local, regional, and international levels while respecting ethical and professional conduct.
- Successfully pursue higher education in world-class universities.
- Become decision-makers, innovators, and leaders in their profession.

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

Competencies – Honors Preparatory Industrial 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 Industrial 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.). Magnetic Induction (2 Cr.). Mechanics 1 (6 Cr.). Mechanics 2 (4 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.). Digital Systems Design (4 Cr.). Linear Electrical Systems and Networks (4 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 Industrial 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.). Electromagnetism (4 Cr.). General Chemistry (4 Cr.). Introduction to Heat Transfer (2 Cr.). Magnetic Induction (2 Cr.). Mechanics 1 (6 Cr.). Mechanics 2 (4 Cr.). Physical Signals (6 Cr.). Physics Laboratory 1 (2 Cr.). Physics Laboratory 2 (2 Cr.). Thermodynamics 1 (4 Cr.). Programming 1 (4 Cr.). Programming 2 (4 Cr.). Computer Assisted Drawing (4 Cr.). Digital Systems Design (6 Cr.). Introduction to Engineering Projects (2 Cr.). Linear Electrical Systems and Networks (6 Cr.). MATLAB (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 Industrial Engineering
180 credits: Required courses (150 credits), Institution's elective courses (26 credits), Open elective courses (4 credits), and USJ General Education Program (26 credits - may be part of the above categories).

Fundamental Courses (176 Cr.)
Required Courses (150 Cr.)
Accounting (4 Cr.). Business Ethics (4 Cr.). Business Law (2 Cr.). Communication Skills (2 Cr.). Control Systems (6 Cr.). Design and Analysis of Experiments (6 Cr.). Digital Factory 1 (6 Cr.). Electrical Systems (6 Cr.). Electronics (6 Cr.). Engineering Economics (6 Cr.). English (4 Cr.). Facilities Planning and Design (6 Cr.). Human Factor and Ergonomics (6 Cr.). Industrial IoT (4 Cr.). Innovation and Design Thinking (2 Cr.). Inventory Control (4 Cr.). Management (4 Cr.). Manufacturing Processes 1 (4 Cr.). Mechanical Structures (6 Cr.). Operations Research and Optimization (6 Cr.). Production Control (6 Cr.). Project Management (4 Cr.). Quality Control & Reliability (6 Cr.). Statistics (4 Cr.). Systems Simulation (6 Cr.). Work Methods and Analysis (6 Cr.). Corporate Internship (2 Cr.). Multidisciplinary Project (6 Cr.). Final Year Project (16 Cr.).

Institution's Elective Courses (26 Cr.), to be chosen from the list below:
Automobile (4 Cr.). Relational Databases (4 Cr.). Sensors and Instrumentation (4 Cr.). Production Chain and Logistics (4 Cr.). Cloud and Digital Transformation (4 Cr.). Computer Aided Drawing and Design (CADD) (4 Cr.). Design of Mechatronic Systems (4 Cr.). Renewable Energy (4 Cr.). Entrepreneurship (2 Cr.). Manufacturing Systems (4 Cr.). Mechatronics and Intelligent Machines (4 Cr.). Industrial Process and Control (4 Cr.). Manufacturing Processes 2 (4 Cr.). C++ Programming (4 Cr.). Robotics (4 Cr.). Space and Micro/Nano Satellite Technologies (4 Cr.). Embedded Systems (4 Cr.). Digital Factory 2 (4 Cr.). Work Ready Now (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10 out of 36 Cr.) - Honors Preparatory Industrial Engineering, Regular Preparatory Industrial Engineering

26 additional credits are validated in the Department of Electrical and Mechanical 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 Industrial Engineering

10 additional credits are validated in the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGES4	English	4
	ARABIC	**4**
	Arabic Language and Culture	**2**
435LALML2 435LALAL2 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**
020DRAES5	Business Law	2
	HUMANITIES	**4**
	Ethics	**4**
020ETHES3	Business Ethics	4
	SOCIAL SCIENCES	**6**
	Professional Integration and/or Entrepreneurship	**2**
020ENTES1 020WRNES1	One Institution's elective course to be selected between: Entrepreneurship Work Ready Now	2
	Other Social Sciences Course	**4**
020GPRES2	Project Management	4
	COMMUNICATION TECHNIQUES	**8**
020TCOES2	Communication Skills	2
020PRMES4	Multidisciplinary Project	2 out of 6
020PFEES6	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 Industrial 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 Industrial 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 Industrial 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 I	2
020IF1CI2	Programming 1	4
020TH1CI2	Thermodynamics 1	6
	Total	**28**
	Required Courses - Regular Preparatory Industrial Engineering	
020AA1NI2	Analysis 1	4
020ALNNI2	Linear Algebra	8
020INMNI2	Magnetic Induction	2
020PP1NI2	Physics Laboratory 1	2
020IF1NI2	Programming 1	4
020TH1NI2	Thermodynamics 1	4
	Open Elective Course	2
	Total	**26**

Semester 3

Code	Course Name	Credits
	Required Courses - Honors Preparatory Industrial 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 Industrial Engineering	
020AN2NI4	Analysis 2	6
020ALBNI3	Bilinear Algebra and Geometry	6
020EMENI3	Electromagnetism	4
020ITCNI3	Introduction to Heat Transfer	2

020MC2NI3	Mechanics 2	4
020PP2NI3	Physics Laboratory 2	2
020PRBNI4	Probability	4
020IF2NI3	Programming 2	4
	Total	**32**

Semester 4

Code	Course Name	Credits
	Required Courses - Honors Preparatory Electrical Engineering	
020AL3CI4	Algebra 3	4
020AN3CI4	Analysis 3	4
020TEDCI4	Digital Systems Design	4
020SRLCI4	Linear Electrical Systems and Networks	4
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 Industrial Engineering	
020DAMNI4	Computer Assisted Drawing	4
020CDFNI4	Differential Calculus	6
020TEDNI4	Digital Systems Design	6
020PIINI4	Introduction to Engineering Projects	2
020SRLNI4	Linear Electrical Systems and Networks	6
020MATNI4	MATLAB	2
064VALEL1	USJ Values in Daily Life	2
	Open Elective Course	2
	Total	**30**

Semester 5

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Industrial Engineering	
020TCOES2	Communication Skills	2
020ELCES1	Electronics	6
020FHEES1	Human Factor and Ergonomics	6
020STMES1	Mechanical Structures	6
020STAES1	Statistics	4
020MEAES1	Work Methods and Analysis	6
020WRNES1 **or** 020ENTES1	Institution's Elective Course: Work Ready Now **or** Entrepreneurship	2

	Total	**32**

Semester 6

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Industrial Engineering	
020SELES2	Electrical Systems	6
020ENEES2	Engineering Economics	6
020IITES2	Industrial IoT	4
020INDES2	Innovation and Design Thinking	2
020PF1ES3	Manufacturing Processes 1	4
020GPRES2	Project Management	4
020GEQES2	Quality Control & Reliability	6
	Open Elective Course	2
	Total	**34**

Semester 7

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Industrial Engineering	
020ASCES3	Control Systems	6
020UN1ES3	Digital Factory 1	6
020PCIES3	Facilities Planning and Design	6
020GEPES3	Production Control	6
	Institution's Elective Course	8
	Total	**32**

Semester 8

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Industrial Engineering	
020ETHES3	Business Ethics	4
020ANGES4	English	4
020GSTES4	Inventory Control	4
020PRMES4	Multidisciplinary Project	6
020ROOES4	Operations Research and Optimization	6
	Institution's Elective Course	8
	Open Elective Course	2
	Total	**34**

Semester 9

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Industrial Engineering	
020CMPES5	Accounting	4
020DRAES5	Business Law	2
020STGES5	Corporate Internship	2
020PEXES5	Design and Analysis of Experiments	6
020MNGES4	Management	4
020SSYES5	Systems Simulation	6

	Institution's Elective Course	8
	Total	**32**

Semester 10

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Industrial Engineering	
020PFEES6	Final Year Project	16
	Total	**16**

COURSE DESCRIPTION

Honors Preparatory Industrial 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, 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 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 the following: Algebraic structures, vector spaces, linear applications, matrices, determinants, linear systems, 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 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, 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 equation and systems of the form X'=A(t)X+B(t), the method of constant variation, Lagrange's method.
Prerequisite: Analysis 2 (020AN2CI3).

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.

This course covers the following: 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 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 subject 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).

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 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).

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, wave length, 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 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 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 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 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 concrete 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 Industrial 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).

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).

020DAMNI4 Computer Assisted Drawing 4 Cr.

This course covers the following: 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.

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).

020TEDNI4 Digital Systems Design 6 Cr.

This course familiarizes students 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 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.

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.

020EMENI3 Electromagnetism 4 Cr.

This course begins with a distinct examination of the stationary electric and magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell's equations. Following the presentation of Maxwell's equations and the electromagnetic (EM) energy, attention is shifted to the propagation of EM waves in vacuum.
Prerequisites: General Analysis (020ANGNI1) - Physical Signals (020SPHNI1).

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.

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.

020ITCNI3 Introduction to Heat Transfer 2 Cr.

This course explores the fundamental principles of heat transfer mechanisms such as conduction, convection, and radiation, with an emphasis on thermal conduction. The objective is to establish the thermal balance and apply Fourier's laws to determine the heat equation. Additionally, students will be able to calculate the thermal resistance of different systems, which is crucial for the design of efficient heat transfer systems. This introductory course on heat transfer provides the necessary foundations to understand and analyze heat transfer phenomena in a variety of systems. This is essential in many fields such as thermal engineering, materials science, thermodynamics, and more.
Prerequisite: Thermodynamics 1 (020TH1NI2).

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.

020SRLNI4 Linear Electrical Systems and Networks 6 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 are extensively covered to provide a comprehensive understanding of electrical circuits.
Prerequisite: Physical Signals (020SPHNI1).

020INMNI2 Magnetic Induction 2 Cr.

This course explores the fundamental principles of magnetic induction and its applications. It covers various topics such as magnetic fields, Faraday's law, electromagnetic induction, Lenz's law, transformers, etc. The course also addresses practical applications of magnetic induction, such as electric generators, electric motors, induction coils, magnetic sensors, etc. Students will acquire the necessary foundations to understand and analyze magnetic induction phenomena in various applications. These concepts are essential in many fields, including electrical engineering, electronics, electromagnetism, energy production, telecommunications, and more.

020MATNI4 MATLAB 2 Cr.

This course covers various key aspects of MATLAB and Simulink, with a particular focus on symbolic computation in calculus and algebra, matrix calculations, programming, and an introduction to Simulink. Students will have the opportunity to explore the advanced features of MATLAB in depth, with an emphasis on its application in

different engineering fields. Symbolic calculus and algebra enable students to manipulate complex mathematical expressions, simplify equations, compute derivatives and integrals, and solve systems of symbolic equations. Students will learn to manipulate matrices and vectors and perform essential matrix operations. Additionally, the course covers practical aspects of MATLAB programming, teaching students how to write custom scripts and functions. Furthermore, the course provides an introduction to Simulink, MATLAB's graphical environment dedicated to modeling and simulating dynamic systems. In summary, this course provides students with a comprehensive understanding of MATLAB and Simulink, emphasizing their application in engineering. Topics include symbolic algebra, matrix calculations, essential programming skills in MATLAB, and an introduction to Simulink for modeling and simulating dynamic systems.
Prerequisites: General Analysis (020ANGNI1) - Programming 1 (020IF1NI2).

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).

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.

020PP2NI3 Physics Laboratory 2 2 Cr.

This course allows students to reinforce their theoretical knowledge through practical applications across 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 (020PP1NI2).

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.

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 Industrial Engineering

020CMPES5 Accounting 4 Cr.

This course covers the following: Definition of Accounting, Accounting Process, Accounting Concepts, Classification of Accounts, Rules of Double Entry Accounting System, Rules of Journal, Current Assets, and Current Liabilities, Concepts of Cost Accounting, Advantages of Cost Accounting, Classification and Elements of Cost, and Preparation of Cost Sheet.

435LALAL2 Arabic Language and Arts 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop essential language skills while exploring a range of cultural topics.
Specific objectives:
- Explore diverse forms of Arabic artistic expression.
- Understand the significance of art within Arab culture and identity.

435LALML2 Arabic Language and Media 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop essential language skills while exploring a range of cultural topics.
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 essential language skills while exploring a range of cultural topics.
Specific objectives:
- Deepen knowledge of major Arabic literary and cinematic works.
- Develop critical analysis and debating skills in Arabic.

020AUTES3 Automobile 4 Cr.

This course introduces students to automotive engineering. It deals with several systems in an automobile such as clutches, manual and automatic gearboxes, torque converter, 4x4 transfer, CV joints, transmission, differential, suspension, wheel geometry, steering box, and braking systems.
Prerequisite: Mechanical Structures (020STMES1) or Mechanical Systems (020SMEES1).

020ETHES3 Business Ethics 4 Cr.

This course is interactive in nature. It includes readings and analysis of basic texts, moments of reflection and debate, awareness of the state-of-the-art in the region, studies of authentic international organizational documents, role plays and projects for a more pragmatic analysis. It is aimed at students wishing to work in public or private companies and in all fields. Its objective is to create awareness of the need for ethics, which is becoming inescapable today, given current trends towards sustainable development, the dissemination of information to stakeholders and transparent competition. It also offers prospective engineers the opportunity to understand business issues from an analytical perspective and to distinguish themselves by their professionalism and informed attitude about ethics. Finally, students will be more alert to the entrepreneurial approaches and the ethical reflection that accompanies them.

020DRAES5 Business Law 2 Cr.

This course provides an overview of the legal framework governing commercial activities and business entities. It covers fundamental concepts related to commercial transactions, the status of merchants, and the regulations governing business establishments.

020CLDES5 Cloud and Digital Transformation 4 Cr.

This course covers the following: A panorama of Cloud technologies and industry and its positioning in the IT landscape. The fundamentals of the Cloud and how it disrupts the way IT is purchased, consumed and operated. The definition of the Cloud, how that is different from traditional IT technically, economically, organizationally and in terms of business efficacy and innovation. The players and their offers. How are multinational firms taking advantage of the Cloud for their businesses? Hands-on labs and a study of a Smart Home use case using the Cloud.

020TCOES2 Communication Skills 2 Cr.

This course highlights the importance of communication for engineering students. It explains that, in academic and professional activities, transmitting information is a powerful tool for convincing and influencing others. This course emphasizes that communication is unavoidable and involves errors and risks that may disturb or distort the reception of information. It provides students with essential basic rules of written, verbal, and non-verbal communication and raises awareness of errors to be avoided.

020CAOES2 Computer Aided Drawing and Design (CADD) 4 Cr.

This course covers computer-aided drawing and design (CADD). Students will employ these powerful tools in the solution of various mechanical engineering problems. CADD includes all the modeling programs and techniques that allow the design of models and products. It also makes it possible to simulate and therefore virtually test products before manufacturing them so that it is then easy to transmit the information to Computer-Aided Manufacturing (CAM). The course also enables students to identify several stages: (a) Creation of a model of the object, (b) Analysis, testing and simulations, (c) Construction of virtual prototypes, (d) Management of large assemblies. It utilizes SolidWorks software for drawing, analysis, design, and testing of mechanical systems and applications.

020ASCES3 Control Systems 6 Cr.

This course introduces important basic concepts in the analysis and design of control systems. It is divided into two parts. The first covers transient and steady-state response analysis of 1st and 2nd order linear systems, as well as frequency-response analysis using Bode, Nyquist and Nichols diagrams. It is followed by an introduction to closed-loop versus open-loop control systems leading to a stability analysis. The second part covers the analysis and design of linear control systems using different types of controllers. The design of such controllers is presented using frequency-response methods, analytical calculations, and experimental techniques. The whole is validated with exercises and workshops using MATLAB/Simulink.
This course also covers the main concepts of discrete system modeling, Z-transform, discrete transfer function and discrete systems stability. The design of digital controllers (discretized classic controllers, dead-beat control), and the implementation of digital controllers using embedded systems and real-time simulations of a system in closed loop are discussed in this course.
Prerequisite: Electronics (020ELCES1).

020STGES5 Corporate Internship 2 Cr.

The corporate internship is a learning opportunity for students to: apply the knowledge they acquired during earlier coursework in a professional environment - acquire professional skills in addition to the theoretical and practical training – experience situations of human relationships that occur in the different environments where engineers may work - acquire experience and knowledge that facilitate future professional integration.

020PCPES2 C++ Programming 4 Cr.

This course covers the following: Structure of a C++ program (declarations, statements, literals, operators), control statements (conditional statements and loops), functions, arrays, structures. Object-oriented programming: Classes and objects, construction, encapsulation, inheritance, virtual functions, abstract classes and polymorphism, operator overloading, exception handling, file handling, generic programming with templates, the Standard Template Library (STL), graphical interfaces with Qt.
Prerequisite: Programming 2 (020IF2NI3 or 020IF2CI3).

020PEXES5 Design and Analysis of Experiments 6 Cr.

This course teaches the application of statistics to reach an optimal process performance, using ANOVA and factorial design. It covers the study of levels and factors leading to better system outcomes. This course also provides knowledge and skills in industrial software systems management, i.e., the planning, procurement, development and integration of software systems in an industrial engineering context. It introduces students to data manipulation using spreadsheets like Excel and data investigation using Access. The course also considers the underlying industrial processes. It prepares students for both technology-intensive professions, e.g. system development (ERD software drawing tool such as Visio is used), and project management software like MS Project, within organizations supplying or acquiring industrial information and control systems.
Prerequisite: Statistics (020STAES1).

020CSMES4 Design of Mechatronic Systems 4 Cr.

This course provides a comprehensive introduction to mechatronics and microcontroller systems, with a strong focus on the integration of mechanical components, electronics, and data-driven control. Students will learn to combine mechanical design with microcontrollers, sensors, and control systems to design and implement functional mechatronic solutions across a range of applications. In addition, students will collaborate on a team-based project that applies these concepts to real-world scenarios, fostering both technical and teamwork skills.
Prerequisite: Sensors and Instrumentation (020CEIES3).

020UN1ES3 Digital Factory 1 6 Cr.

This course aims to study artificially intelligent agents. It portrays several methods of implementing these agents: from simple reflex agents to utility-based agents as well as learning agents. It first covers greedy and A* search, the implementation of games through the Minimax and Expectimax algorithms, Markov Decision Processes (MDP) and Reinforcement Learning (RL).
The course introduces students to main Machine Learning (ML) algorithms as well as practical ML engineering experience with regards to their application to realistic datasets through Python implementations that make use of state-of-the-art libraries such as Scikit-learn, TensorFlow and Keras.
Prerequisite: Programming 2 (020IF2NI3 or 020IF2CI3).

020UN2ES4 Digital Factory 2 4 Cr.

This course introduces the industrial software and Information Systems used to organize companies and businesses.
Prerequisite: Digital factory 1 (020UN1ES3).

020SELES2 Electrical Systems 6 Cr.

This course covers the following: Magnetic materials and circuits - Three-phase systems - Constitution, modeling and operation in steady state of the DC machine - Concept of rotating field - Constitution, equivalent diagrams and operation in steady state of the asynchronous machine and the synchronous machine.
This course also introduces students to the expanding field of power electronics in the domain of industrial applications. It is articulated around the following main topics: first, the characteristics of power semiconductor devices (ideal vs practical), which are used as switches to perform the power conversions from AC-DC, DC-DC, DC-AC and AC-AC, then an in-depth study of the operation, analysis, and design of single-phase and three-phase thyristor-based power rectifiers.
Prerequisites: Electromagnetism (020EMENI3 or 020EMECI3), Linear Electrical Systems and Networks (020SRLNI4 or 020SRLCI4).

020ELCES1 Electronics 6 Cr.

This course introduces the basics of electronics and electronic circuits to students in the mechanical engineering program. Its objectives are to provide a concise treatment of the basic concepts of electronic components and to introduce students to basic analog and digital circuits. The course covers the basics of diodes, semiconductors, transistors, operational amplifiers and their applications, digital circuits and systems, and basic instrumentation.
Prerequisite: Linear Electrical Systems and Networks (020SRLNI4 or 020SRLCI4).

020SEMES3 Embedded Systems 4 Cr.

This course covers the following: Embedded systems: Introduction, motivation and applications – Types of the embedded systems – Integration and implementation levels – Variable types – Fixed and floating point variable formats – Schematics and PCBs – FPGA: Introduction, Basic Logic Element (BLE) architecture, input/output – Introduction to Quartus Prime and Altera FPGA – VHDL: Introduction, basics, combinatorial and sequential behavior, process and clocks, advanced concepts – Introduction to co-design: link between hardware and software – NIOS II processor creation and programming.
Prerequisites: Digital Systems Design (020TEDNI4 or 020TEDCI4), Programming 1 (020IF1NI2 or 020IF1CI2).

020ENEES2 Engineering Economics 6 Cr.

This course covers the following: Analysis of engineering costs and capital investments. Applications of classical optimization, mathematical programming, and the theory of production to the analysis of investment proposals. Evaluation and selection of individual projects and formulation of capital investment programs.
Prerequisites: Analysis 2 (020AN2NI4 or 020AN2CI3), Linear Algebra (020ALNNI2) or Algebra 1 (020AL1CI2).

020ANGES4 English 4 Cr.

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

020ENTES1 Entrepreneurship 2 Cr.

This course covers the following: Design thinking, Problem tree, Business Model Canvas, Presentation – Value Proposition Canvas, Customer segmentation (Product-market fit), Competitive analysis, Go2market strategy, Presentation – Basic budgeting and financial figures, Pitch deck, Presentation.

020PCIES3 Facilities Planning and Design 6 Cr.

This course introduces topics such as analysis and design of work space and flow, facilities planning, location and layout, flow analysis and activity relationship, capacity and space requirements, material handling systems, material flow, and physical distribution, storage and warehousing.
Corequisite: Production Control (020GEPES3).

020PFEES6 Final Year Project 16 Cr.

The final year project is a culminating major engineering design experience carried out by groups of 2 to 4 students under the supervision of a faculty member. Students must define the project, specify its objectives, perform a state of the art of the studies topic, establish the project specifications and select a design method. In this project, students must apply the knowledge acquired throughout their academic years of study and provide a final product that has gone through all stages of design, modeling, analysis, testing and evaluation. A final report and two oral presentations are the main deliverables of the project.
Prerequisite: Validate 150 credits.

020FHEES1 Human Factor and Ergonomics 6 Cr.

This course introduces the field of human factors engineering. Human factors experts draw from research in engineering, psychology, cognitive science, and organization science to solve problems and to invent designs to prevent or mitigate the harm from errors and accidents using technology.
Topics covered include: Consideration of human characteristics in the requirement determination for the design of systems, organizations, facilities, processes, and products to enable human-centered design which considers human abilities, limitations, and acceptance.

020IITES2 Industrial IoT 4 Cr.

This course covers the following: Introduction to databases – IoT reference model – End-to-end IoT chain – Constraints and challenges of connected devices – Hardware architecture of connected devices – Introduction to Data Networks – Wireless LAN – Routing protocols– IPv6 for IoT – Application layer – Operating systems for connected devices – Hands-on deployment of the end-to-end IoT chain.

020PRNES4 Industrial Process and Control 4 Cr.

This course covers the following: Programmable Logic Controllers (PLC) – Distributed Control Systems (DCS) – Supervisory Control And Data Acquisition (SCADA) – Human Machine Interface (HMI) – Remote Terminal Unit (RTU) - Fieldbus (MODBUS, PROFIBUS, PROFINET, HART) – CPU memory (executive, system, data, program) – Memory types (RAM, ROM, EPROM, EEPROM) - Data type (input, output, digital, analog) – SCADA architecture (field level, automation level, management level) – Intelligent Electronic Devices (IED) – Communication (message, sender, receiver, master, slave, serial, parallel) – Transmission (simplex, duplex, point to point, multipoint, guided, unguided) – Topology (mesh, star, bus, ring, hybrid) – Transmission media (twisted pair, coaxial, patch cable, crossover cable, fiber optic) – Data coding – Operational Block (OB) – Function (FC) – Function Block (FB) – DataBlock (DB) – Scan cycle – Interrupt – MODBUS data types (discrete input, coil, input register, holding register).

020INDES2 Innovation and Design Thinking 2 Cr.

This course is designed to cultivate a creative mindset and the practices essential for driving innovation. Students will explore the nature of creativity and the sources of groundbreaking ideas. The course emphasizes that fostering the belief in one's creative potential is the first step toward becoming an innovative thinker and leader. It also covers strategies for enhancing creative confidence and empowering others to adopt this mindset. Additionally, students will be introduced to the design thinking process, a proven methodology for systematic innovation. The course guides students through each stage of design thinking, from identifying needs and building empathy to generating insights, prototyping, and experimenting. Ultimately, the course focuses on cultivating an innovative mindset within professional environments and learning how to inspire and lead others in the pursuit of creative solutions.

020GSTES4 Inventory Control 4 Cr.

This course is an introduction to inventory control, detailed forecasting techniques focusing on exponential smoothing and moving average methods, deterministic lot sizing, safety stocks and reorder points, coordinated replenishments, correlation, regression.
Prerequisite: Statistics (020STAES1).

020MNGES4 Management 4 Cr.

This course is a study of management theories, emphasizing the management functions of planning, decision-making, organizing, leading and controlling.

020PF1ES3 Manufacturing Processes 1 4 Cr.

This course covers the main manufacturing processes used in the industry for different types of materials (metal, glass, plastics, rubber, composite materials, ceramics). It explains the concept of manufacturing in its large sense: the factory organization and design, the selection of processing operations and the production systems. The covered topics include the study of phase diagrams for different types of metal alloys, a global description of raw materials, and the operations used for their extraction and preparation (for metals, ceramics, polymers, and composites). Also, the course introduces the material removal processes. It details the different operations made by a lathe, the basics of CNC machines and the G-code programming language for milling and turning processes.
Prerequisite: Computer Assisted Drawing (020DAMNI4 or 020DAMCI4).

020PF2ES4 Manufacturing Processes 2 4 Cr.

This course covers the main manufacturing processes used in the industry for different types of materials (metal, glass, plastics, rubber, composites, ceramics). It explains the techniques applied during the preparation of a

product, from the fabrication of the primary parts to the finishing of the final assembled product. In addition to the "material removal processes" explained in the "Manufacturing Processes 1" course, the covered topics include: solidification processes (casting, molding), particulate processing, deformation of metals and plastics, and assembly operations (welding, over molding, threading) Also, the course describes some advanced processes and technologies such as waterjet cutting, laser cutting, layered design, 3D printing and nanotechnology.
Prerequisite: Manufacturing Processes 1 (020PF1ES3).

020MNSES5 Manufacturing Systems 4 Cr.

This course introduces basic manufacturing systems from both design and operations perspectives. Topics covered include: Deterministic models for single and parallel machines, flow shops and flexible shops, assembly lines, transfer lines, production scheduling and flexible manufacturing systems. Additional topics related to current manufacturing technology and challenges are also covered in this course.
Prerequisite: Production Control (020GEPES3).

020STMES1 Mechanical Structures 6 Cr.

This course introduces materials and chemical bonds, along with materials properties and degradation phenomena. It covers the modeling and resolution of problems related to mechanisms made of non-deformable (rigid) bodies, such as bar-linkages and associated kinematics. Topics include kinematic diagrams, parameterization, operation analysis, determination of equations of motion, and calculation of forces applied to parts, as well as the generated and dissipated mechanical energies. The course also introduces students to the fundamentals and principles of multi-bar connections, gears, and cams.
Additionally, the course addresses the design of common machine elements, emphasizing their behavior under static and dynamic loads. The elements studied include transmission shafts, keys, couplings, bearings, lubrication, and spur gears.
The course also explores the phenomena involving a deformable solid subjected to external loads, covering fundamental hypotheses of beam theory and elasticity, geometric characteristics of sections, types of stresses, generalized Hooke's law, axial stresses (mechanical and thermal), and deformations. Practical work will be conducted on modeling several bar systems to study and visualize the movements of the mechanisms.
Prerequisites: Computer Assisted Drawing (020DAMNI4 or 020DAMCI4), Mechanics 2 (020MC2CI3 or 020MC2NI3).

020MMIES5 Mechatronics and Intelligent Machines 4 Cr.

This course offers a comprehensive exploration of mechatronics and intelligent machines, emphasizing sensors, actuators, system modeling, computer simulation, information processing, perception, cognition, planning, control, and system design. Students will gain practical knowledge through hands-on projects and applications.
Prerequisite: Control Systems (020ASCES3) or Linear Control (020AULES2).

020PRMES4 Multidisciplinary Project 6 Cr.

This project brings together students from different programs and/or concentrations where each student participates in the execution of a task related to their field. It aims to provide hands-on design experience, strengthen their analysis capacity, and develop their communication skills and teamwork ability. In this project, students must apply the knowledge acquired throughout their academic years of study and provide a final product that has gone through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

020ROOES4 Operations Research and Optimization 6 Cr.

This course teaches how to formulate, analyze, and solve mathematical models that represent real-world problems in linear programming, networks flows, integer programming, Markov chains, Poisson processes, and their application to queueing systems.
Prerequisite: Production Control (020GEPES3).

020GEPES3 Production Control 6 Cr.

The course is an introduction to production planning and control techniques and their application to designing integrated production systems. It emphasizes the development and use of mathematical models used to analyze and improve the use of material, labor, and information flow, resource and capacity planning, and shop floor control and scheduling in production environments.
Prerequisite: Work Methods and Analysis (020MEAES1).

020CPLES4 Production Chain and Logistics 4 Cr.

This course introduces students to the study of an optimal production chain, taking into account technical, time, human and logistical factors.

020GPRES2 Project Management 4 Cr.

This course explains how effective project management ensures that a project is completed on time, within budget, and with high quality. Specific techniques for accomplishing these three goals are not always so obvious. The purpose of this course is teaching students these successful techniques, and exposing them to a variety of skills to manage the budget, schedule, and quality of projects that they are or will be responsible for.

020GEQES2 Quality Control & Reliability 6 Cr.

This course defines quality and reliability and provides key concepts, sampling methods, and data presentation tools. It covers various control charts for variables and attributes and discusses process capability, measurement system analysis, error propagation, and tolerance intervals. Acceptance sampling and major concepts of experimental design are also covered. It introduces the reliability concepts, the evaluation of system reliability of series and parallel systems, K-of-N systems, and standby systems. Parameter estimation aspects for Weibull and Lognormal distributions and sampling procedures for reliability life testing are discussed.
Prerequisite: Statistics (020STAES1).

020BDRES2 Relational Databases 4 Cr.

This course provides a comprehensive introduction to database systems, emphasizing both theoretical foundations and practical applications. Topics include logical models of databases, relational algebra, and database design principles such as functional dependencies. Students will gain proficiency in Structured Query Language (SQL), covering both basic commands and advanced queries. Additional topics include views, triggers, functions, and stored procedures within database management systems. The course also explores indexing structures for physical database design. Students will develop skills to translate relational algebra into SQL and design efficient database solutions.

020ERNES6 Renewable Energy 4 Cr.

This course offers a comprehensive exploration of the latest advancements in renewable energy technologies and their diverse applications. It aims to foster an understanding among students of the potentials and unique characteristics of renewable energies, particularly in the area of electricity generation. The course addresses key questions such as the nature of these energy resources, methods for their capture and transformation, and the various forms in which they can be utilized.
Throughout the program, students will explore specific topics, including the Principles of Solar Radiation, PV system components, design, selection & sizing. The course also explores the origin and power of wind, wind energy system components, turbine design & control, electrical aspects of wind turbines, and the essentials of wind energy system selection & sizing, along with an overview of the control structures and grid connection techniques. The course also introduces battery storage system technologies, their structure, principle of operation, performance and efficiency, battery charge/discharge cycles, Battery Management Systems (BMS), battery models, equalization techniques, along with an introduction to fuel cells.
This comprehensive examination equips students with the knowledge and skills needed to navigate the complex landscape of renewable energy.

020ROBES5 Robotics 4 Cr.

This course aims to introduce some theoretical and practical fundamentals of robotics engineering related to electrical and mechanical domains. The concept of robotics is introduced starting from the sensors, actuators and closed loop representation, going through dynamics and kinematics equations, and reaching control of robots using linear, non-linear, and adaptive controllers. Concepts of dynamic response related to vibration and motion planning are presented. The principles of operation of various actuators are discussed including pneumatic, magnetic, piezoelectric, linear, stepper, etc. Advanced feedback mechanisms are implemented using software executing in an embedded system. The concepts for real-time processor programming, image processing and artificial intelligence are also presented in this course. Neural networks and advanced controllers are shown along with their implementation using microcontrollers and/or software-based (MATLAB, LabVIEW, etc.) and emphasized in this course.

020CEIES3 Sensors and Instrumentation 4 Cr.

This course provides a general review of the main characteristics of a sensor (sensitivity, time response delay, measurement errors). Several types of sensors, such as optical sensors, temperature sensors, tachometric sensors, position and displacement sensors, force, weight and torque transducers, are described and studied in detail.
Prerequisite: Electronics (020ELCES1) or Digital Electronics (020ELNES2).

020SSTES4 Space and Micro/Nano Satellite Technologies 4 Cr.

This course covers the following: Micro/nano satellite mission, orbits design and analysis, subsystem scheme, micro/nano satellite configuration design, system performance determination and analysis, reliability and safety analysis technical processes of satellite development, attitude system determination and control, design of the micro/nano satellite integrated electronic system, architecture of micro/nano satellite integrated electronic and relevant technical specifications, concept of micro/nano satellite testing description, ground station types and related softwares, STK tracker software, design and implement (tabletop) a nanosatellite of type Cubesat 1U using commercial components and boards.
Prerequisites: Electronics (020ELCES1), Mechanics 1 (020MC1NI1 or 020MH1NI1).

020STAES1 Statistics 4 Cr.

This course provides a rigorous foundation in statistical inference, equipping students with the tools to make sound decisions based on data. It begins with a review of random variables and probability distributions, before distinguishing between descriptive and inferential statistics. Students will explore key concepts of sampling distributions and learn how to construct and interpret confidence intervals for means, variances, and proportions. The course then delves into parameter estimation techniques, including the method of moments and maximum likelihood estimation. In the latter half, emphasis is placed on the theory and application of statistical hypothesis testing for different types of parameters and distributions. Students will analyze real-world problems involving tests for means, variances, proportions, independence, and goodness-of-fit. The course concludes with an introduction to linear regression and non-parametric statistical tests.
Prerequisite: Probability (020PRBNI4) or Algebra 3 (020AL3CI4).

020SSYES5 Systems Simulation 6 Cr.

This is an introductory course to modeling techniques and simulation. It introduces solutions to industrial and service systems problems and challenges using process simulation to enhance organizational performance in an increasingly complex, turbulent, and uncertain industrial environment. This course uses discrete-event simulation, random number generation and testing, and the design of simulation experiments as tools to model the behavior of industrial systems for process analysis and process improvement. It includes a practical lab that introduces modeling concepts of a modern simulation language.
Prerequisite: Statistics (020STAES1).

020MEAES1 Work Methods and Analysis 6 Cr.

This course is designed to teach the concepts of work and man-machine interface, analysis, design and measurement of work, method study, and recording at different levels, process analysis and improvement, applications in design/ modification. The course also covers the operation analysis, manual work design, time study, predetermined time systems, job analysis, work environment design, and design of cognitive work.
Prerequisite: Analysis 2 (020AN2NI4 or 020AN2CI3).

020WRNES1 Work Ready Now 2 Cr.

This course covers the following topics: Personal Development - Communication Skills - Job Seeking Skills - Work Behaviors.