REGULAR PREPARATORY IN MECHANICAL ENGINEERING

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campus Where the Program Is Offered: CST, CLN, CLS, CZB

OBJECTIVES

The objectives of the Mechanical 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 (116 credits), Open elective courses (4 credits).
USJ General Education Program (10 credits – may be part of the above categories – *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 (116 Cr.)
Mathematics (48 Cr.): Analysis I (4 Cr.), Analysis II (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.), Supplementary Mathematics (2 Cr.).
Sciences (36 Cr.): Electromagnetism (4 Cr.), General Chemistry (4 Cr.), Introduction to Heat Transfer (2 Cr.), Introduction to Materials Science (2 Cr.), Mechanics I (6 Cr.), Mechanics II (4 Cr.), Physical Signals (6 Cr.), Physics Laboratory I (2 Cr.), Physics Laboratory II (2 Cr.), Thermodynamics I (4 Cr.).
Programming (12 Cr.): Programming I (4 Cr.), Programming II (4 Cr.), Programming III (4 Cr.).

Engineering Fundamentals (16 Cr.): Computer Assisted Drawing (4 Cr.), Introduction to Engineering Projects (2 Cr.), Linear Electrical Systems and Networks (6 Cr.), Matlab (2 Cr.), Statics for Mechanical Engineering (2 Cr.).
Humanities (4 Cr.): Engineering at the Service of the Community (2 Cr.), USJ Values (2 Cr.).

Open Elective Courses (4 Cr.)

SUGGESTED STUDY PLAN

Semester 1

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

Semester 2

Code	Course Name	Credits
020AA1NI2	Analysis I	4
020ISMNI2	Introduction to Materials Science	2
020ALNNI2	Linear Algebra	8
020PP1NI2	Physics Laboratory I	2
020IF1NI2	Programming I	4
020TH1NI2	Thermodynamics I	4
	Open Elective	2
	Total	**26**

Semester 3

Code	Course Name	Credits
020AN2NI4	Analysis II	6
020ALBNI3	Bilinear Algebra and Geometry	6
020EMENI3	Electromagnetism	4
020ITCNI3	Introduction to Heat Transfer	2
020MC2NI3	Mechanics II	4
020PP2NI3	Physics Laboratory II	2
020PRBNI4	Probability	4
020IF2NI3	Programming II	4
	Total	**32**

Semester 4

Code	Course Name	Credits
020DAMNI4	Computer Assisted Drawing	4
020CDFNI4	Differential Calculus	6
020PIINI4	Introduction to Engineering Projects	2
020SRLNI4	Linear Electrical Systems and Networks	6
020MATNI4	Matlab	2
020IF3NI4	Programming III	4
020STMNI4	Statics for Mechanical Engineering	2
064VALEL1	USJ Values	2
	Open Elective	2
	Total	**30**

COURSE DESCRIPTION

020AA1NI2 Analysis I 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 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 learnings prepare students to tackle complex mathematical problem-solving tasks.

020AN2NI4 Analysis II 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 I (020AA1NI2)

020ATONI2 Atomic Structure and Chemical Bonding 2 Cr.

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

020ALBNI3 Bilinear Algebra and Geometry 6 Cr.

This course provides students with a solid understanding of fundamental concepts, including the reduction of endomorphisms, pre-Hilbert spaces and endomorphisms of Euclidean spaces. Throughout this course, students will develop proficiency in techniques for reducing matrices and endomorphisms, along with their practical applications such as calculating matrix powers, solving linear recurrent sequence systems and utilizing linear recurrent sequences for 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)

020BIMNI4 Building Information Modeling 2 Cr.

This course enables the civil engineering students to get to know the notion of BIM (Building Information Modeling), its impact on the construction industry through the software « Revit Structural » from Autodesk. The initiation to BIM will be carried out through multiple examples, exercises reaching the level of being able to create a 3D model.

020DAINI4 Computer Assisted Drawing 4 Cr.

This course empowers civil engineering students with the skills to proficiently utilize Autodesk's AutoCAD software. Throughout the course, students will actively engage in hands-on exercises focused on civil drawings, structural elements, rebar placement, and the layout of apartments and building sections. The course structure is designed to progressively guide students through key concepts, beginning with an introduction to Computer-Aided Design (CAD), covering the graphical interface, and essential commands such as Line, Erase, Copy, Move, and Rotate. The aim of this course is to provide students with a solid foundation in using AutoCAD, a widely adopted software within the civil engineering community. This knowledge will empower them to effectively contribute to the field by producing accurate and professional engineering drawings.

020DAMNI4 Computer Assisted Drawing 4 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.

020COANI4 Computer-Aided Design 4 Cr.

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

020CDFNI4 Differential Calculus 6 Cr.

This course is an in-depth exploration of differential equations and systems of ODEs. Fundamental concepts such as vector norms, subspaces, bases, and open and closed balls will be 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 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 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.

020MADNI1 Discrete Mathematics 6 Cr.

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 vector field flux and circulation. Stationary local equations are introduced as a special case of Maxwell equations. Following the presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is shifted to the propagation of EM waves in vacuum.
Prerequisites: General Analysis (020ANGNI1) and 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.

020CIFNI4 Fluid Kinematics 2 Cr.

This course introduces the fundamental principles of fluid kinematics. It explores the motion and deformation of fluids without focusing on the forces that produce them. Topics covered include mathematical descriptions of fluid motion, streamlines, particle trajectories, velocity fields, deformation, and potential flows. The course emphasizes the understanding of kinematic concepts and their application in the analysis of fluid flows.
Prerequisite: Hydrostatics (020STFNI2)

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 learn to formulate coherent arguments, justify calculation steps and prove mathematical results. At 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 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.

020TCGNI2 General Chemistry Laboratory 2 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 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.
Prerequisite: General Chemistry (020CHGNI1)

020GELNI4 Geology 2 Cr.

This course aims to introduce fundamental concepts of geology. It focuses on structural geology, stratigraphy and petrography. It covers brittle and ductile deformation and explains the behavior of 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.

020STFNI2 Hydrostatics 2 Cr.

This course introduces the fundamental principles and concepts of fluid statics. It explores the behavior of fluids at rest and focuses on the study of forces and pressures exerted by fluids on immersed surfaces. Topics covered include hydrostatic pressure, buoyancy, hydrostatic forces on submerged surfaces, stability of floating and submerged bodies, and fluid statics applications. The course emphasizes problem-solving techniques, practical applications, and the development of critical thinking skills in the context of fluid statics.

020CITNI4 Inorganic Chemistry and Laboratory 4 Cr.

This course allows students to acquire solid skills in the field of crystallography: compact and pseudo-compact stacking of metals, interstitial sites, metallic alloys, and metallic bonds. 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.

020IMFNI4 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.

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 I (020TH1NI2)

020ISMNI2 Introduction to Materials Science 2 Cr.

This course begins with an introduction to materials and chemical bonds. It allows students to master the structure of solid, amorphous and crystalline materials with their chemical compositions and crystal defects. Then the properties of the materials (physical, chemical and mechanical) and the phenomena of degradation will be approached (ageing, deterioration, corrosion, etc.) in addition to the use of the materials. Finally, the materials are divided into three main parts and explained: metallic materials (alloys, cast iron and steel), polymer materials and mineral materials. Examples of common applications are discussed after each part in order to familiarize students with the links between structure and properties sought in mechanical engineering.

020CIHNI4 Kinetics of Chemical Reactions 2 Cr.

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

020ALNNI2 Linear Algebra 8 Cr.

This course enables students to manipulate complex numbers and explore their properties to perform calculations and solve equations. They also develop an understanding of geometric transformations such as translations, rotations and homothety. This module 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 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 also learn to represent these transformations using matrices. Additionally, they master the computation of determinants, which play a key role in the study of linear systems and their solutions. By acquiring these knowledge and skills, students are 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 will be 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 also 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) and Programming I (020IF1NI2)

020MC1NI1 Mechanics I 6 Cr.

Particle mechanics is a branch of physics that studies the motion of objects by considering them as dimensionless mass points. It simplifies the study of physical systems by neglecting the dimensions and internal structure of objects, focusing solely on their overall motion. In this case, the object under study is assumed to be point-like, meaning it has no significant spatial dimensions, which simplifies calculations by considering only the object's mass and its position in space. The fundamental principles of particle mechanics are based on Newton's laws, which describe the relationship between the applied force on an object, its mass, and its motion. By using these principles, one can analyze the motion of a particle by studying the applied forces, the object's mass, and the initial conditions. Particle mechanics provides an essential foundation for understanding more advanced concepts in classical mechanics, such as kinematics, dynamics, laws of motion, energy, etc.

020MC2NI3 Mechanics II 4 Cr.

Solid mechanics is a branch of mechanics that studies the motion and equilibrium of objects considered as rigid bodies. A rigid body is an object in which different parts do not deform relative to each other when subjected to external forces. This course covers the laws of mechanics for systems, focusing specifically on solids. It enables students to apply various methods to determine the center of mass of a solid and study its translational and/or rotational motion around a fixed axis. Once the definition of the force system in mechanics is provided, along with all the derived laws, students gain proficiency in applying static, dynamic, and energetic laws to solve complex mechanical problems.
Prerequisite: Mechanics I (020MC1NI1)

020CORNI3 Organic Chemistry 4 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.

020PCONI4 Organic Chemistry Laboratory 2 Cr.

This practical work allows students to master the methods of extraction, filtration, purification and synthesis of organic products. They apply the theories explained in the course by concretizing the reactions of organic chemistry such as the extraction of caffeine from tea, the synthesis of aspirin, the synthesis of dibenzalacetone (aldol condensation), the Cannizaro reaction, the chromic oxidation of menthol and the preparation of the isoamyl ester. In addition, column chromatography is explained.
Prerequisite: Organic Chemistry (020CORNI3)

020SPHNI1 Physical Signals 6 Cr.

The primary objective of this course is to ensure students develop a comprehensive grasp of 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 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.

020PP2NI3 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 (020PP1NI2)

020PRBNI4 Probability 4 Cr.

The Probability 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 learn techniques such as combinations, permutations and arrangements. Furthermore, they 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 by using probability distributions. Finally, students explore continuous random variables, with a focus on an extensive examination of cumulative distribution functions, expectation and variance.
Prerequisite: Analysis I (020AA1NI2)

020IF1NI2 Programming I 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, and a brief overview on recursive structures.

020IF2NI3 Programming II 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 I (020IF1NI2)

020IF3NI4 Programming III 4 Cr.

This course covers advanced programming concepts in Python. It includes a systematic study of existing sorting algorithms and how to calculate their time complexity. The course explores applying recursion to sorting algorithms with a recursive structure. It also covers file management for saving or reading structured or unstructured data, creating and manipulating relational databases, building command-line interfaces, using specialized libraries for scientific computing and data analysis, and connecting to remote sites to retrieve or submit data through programming interfaces (APIs).
Prerequisite: Programming I (020IF1NI2)

020STANI4 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 (020MC1NI1)

020STMNI4 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 (020MC1NI1))

020CMTNI1 Supplemental Mathematics 2 Cr.

Proof by induction - Definite and Indefinite Integrals: review of derivatives, integrals, area under a curve, a few techniques of integration - Limits of functions: Min-Max theorem, Sandwich theorem, comparative growth rates - Trigonometric functions: sin and cos functions, solving equations and inequalities.

020TH1NI2 Thermodynamics I 4 Cr.

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

020TH2NI3 Thermodynamics II 4 Cr.

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

0209TOGNI4 Topography 2 Cr.

The objective of this course is to provide an introduction to 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.

020OPTNI3 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). The impact of extended and narrow-spectrum light sources is also examined.
Prerequisite: Physical Signals (020SPHNI1)

020PHONI3 Wave Physics 4 Cr.

This course offers students a solid foundation for understanding the fundamental principles of sinusoidal waves, their propagation, and their significance in various applications. It covers essential concepts related to transverse mechanical waves through the study of progressive and standing waves on a string. The course further explores longitudinal mechanical waves, specifically focusing on sound waves in a tube and their behavior at points of discontinuity. Additionally, students engage in a comprehensive study of electromagnetic waves, including an examination of Maxwell's equations, with a particular emphasis on progressive plane waves in a vacuum. Furthermore, the course introduces students to seismic waves and their various types.
Prerequisite: Physical Signals (020SPHNI1)