Université Saint-Joseph de Beyrouth
Faculté d'ingénierie et d'architecture
École supérieure d'ingénieurs de Beyrouth

Saint-Joseph University of Beirut

Faculty of Engineering and Architecture

School of Engineering of Beirut

ESIB

Catalog 2025-2026

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FACULTY OF ENGINEERING AND ARCHITECTURE (FIA)

HISTORY

Known for its history and commitment to academic excellence, the Faculty of Engineering and Architecture was founded under the new bylaws of the Saint Joseph University of Beirut, enacted on June 10, 1975. This change marked the transition from the School of Engineering of Beirut (ESIB) to the Faculty of Engineering, a decisive step in the academic development of the University.

The Faculty of Engineering includes four major institutions:

- The School of Engineering of Beirut (ESIB), founded in 1913, which represents a pillar of engineering excellence in Lebanon

- The School of Mediterranean Agricultural Engineering (ESIAM), established in 1979, which plays a crucial role in the agronomy field and the development of agriculture in Lebanon

- The National Institute of Telecommunications and Informatics (INCI), founded in 1985, which is a reference in information technology

- The School of Architecture of Beirut (ESAR), established in 2023, which brings a new dimension to the Faculty by integrating architecture into its expertise.

In 2023, after the successful integration of ESAR into the Faculty of Engineering, the latter officially became the Faculty of Engineering and Architecture (FIA), therefore displaying its engagement towards the training of renowned engineers and architects in order to respond to contemporary challenges.

SCHOOL OF ENGINEERING OF BEIRUT (ESIB)

HISTORY

In 1910, the Rector of the "Académie de Lyon (France)", Mr. Paul JOUBIN, reported to the Council of the University of Lyon the potential benefits of establishing an academic presence in the Middle East. A commission was formed and undertook several missions to Lebanon and the Middle East to bring this idea to life.

On November 14, 1913, the French School of Engineering of Beirut (EFIB) was inaugurated alongside the French School of Law. An admission test to EFIB took place on October 17, 1913, and 19 candidates were admitted. By the end of the first preparatory year, 14 students were considered suitable for the second year of study.

Due to World War I, on November 2, 1914, diplomatic relations between France and the Ottoman Empire were severed, and the school buildings were requisitioned on November 14. An armistice was signed on the island of Moudros on October 30, 1918, allowing plans for the school's reopening to be set in motion once again.

After an agreement was signed on January 27, 1919, between the Lyon Association for the Development of Higher and Technical Education Abroad and the Society of Jesus, the EFIB officially opened on November 10, 1919. The program duration was initially set at three years, then extended to four years starting in 1936.

The model for the School of Engineering of Beirut was undoubtedly "Ecole Centrale de Lyon", emphasizing a general training for polyvalent civil engineers with potential for further specialization. This program was simply altered to adapt it to Lebanese requirements. As a result of this similarity, the engineering degree awarded to EFIB students held the same value as that of the "Ecole Centrale de Lyon". EFIB students could therefore attend specialization courses at "Ecole Centrale de Lyon" without an entrance exam. The first Engineering Degree (called "Diplôme" in the French system) was awarded to Mr. Gabriel Rezkallah ARACTINGI in 1922.

Initially, courses focused on civil engineering, mechanics, and electricity. Over time, civil construction, public works, and hydraulics gained importance. In 1942, alongside the Civil Engineering program, an Industry program was introduced to train engineers in utilizing local industrial resources during the war. At the same time, the "National Committee of Fighting France" also authorized the school to offer science courses during the war. In 1945, the Industry program was replaced by an Architecture program, better suited to the country's needs.

In 1949, EFIB was renamed the "School of Engineering of Beirut" (ESIB). For 40 years, EFIB and then ESIB remained the first and only School of Engineering in Lebanon and the Middle East, training the region's first engineers, who were Lebanese, Syrian, Egyptian, Palestinian, Iranian, Turkish, etc.

In 1959, the Electromechanical Engineering program was introduced.

In 1963, the study duration was extended to 5 years after the Lebanese Baccalaureate (Freshman according to the US System), and in October 1971, the School relocated to its current premises in Mar Roukoz. During this time, new concentrations were introduced. Notably, in the academic years 1968-1969 and 1972-1973, the School trained geographic engineers for the Lebanese Ministry of National Defense.

The events of 1975 forced the school, completely plundered, to close its doors again in March 1976, but courses resumed in December 1976. ESIB became part of the new Faculty of Engineering of the Saint Joseph University of Beirut (USJ). Significant efforts have been made since 1977 to equip the laboratories with modern, high-performance equipment. In 1978, the programs were restructured, and the third-year concentrations were adapted to meet the new needs of the market.

In 1979, the engineering preparatory classes (first two years) were restructured, with the creation of the Higher and Special Mathematics classes preparing students for the admission tests of the French Grandes Ecoles (Ecole Polytechnique, Ecole Centrale, Ecole Supélec, Ecole

Nationale des Ponts et Chaussées, Ecole des Mines, Ecole de Télécom, etc.), held in Lebanon under the responsibility of the French Embassy.

Between 1978 and 1980, ESIB relocated six times due to the Lebanese war, resuming activities in its Mar Roukoz premises in October 1980.

Since 1993, the normalization of the situation allowed the gradual establishment of postgraduate programs (Master and PhD). The renewed partnership with France, from 1996 to 2000, accelerated this process. In 1998, the Faculty of Engineering founded its teaching and testing laboratories as Research Centers. ESIB includes five research centers: The Wajdi Najem Regional Center for Water and the Environment, the Lebanese Center for Construction Studies and Research, the Center for Electrical Industries and Telecommunications, the Center for Computer Science, Modeling and Information Technology, and the Center for Physics and Chemistry.

Starting October 2001, ESIB adopted a new admission system based on a selection by one of the following three methods: early admission through the study of school records, an entrance exam, or achieving the Mention Very Good and above on the Lebanese or French Baccalaureate. The objective of this system is to allow the best students to be admitted to ESIB very early.

In 2003, ESIB, within the framework of the Faculty of Engineering, adopted the "European Credit Transfer and Accumulation System" (ECTS). At the same time, it signed co-graduation agreements with several major schools of engineering in France. In September 2005, it restructured its Master's degrees.

In September 2013, recognizing the strategic importance of the Oil and Gas sector, ESIB launched its first Master in Oil and Gas: Exploration, Production and Management (Upstream and Downstream), in collaboration with the "Institut Français du Pétrole" (IFP School), making it the first ESIB program fully taught in English.

In 2015, ESIB began the process of accrediting its engineering programs. At the same time, the Electrical and Mechanical Engineering program was divided into two programs: The Electrical Engineering (EE) program with concentrations in Electromechanical Engineering and Industrial Systems, and the Computer and Communications Engineering (CCE) program with concentrations in Software Engineering and in Telecommunication Networks.

In 2017, a Chemical and Petrochemical Engineering program and a Master in Data Science were created in collaboration with the Faculty of Science of the Saint Joseph University of Beirut. In 2020, the Mechanical Engineering program was launched at ESIB. In 2022, a section of the Computer and Communications Engineering program entirely taught in English opened at ESIB. In 2024, ESIB launched the Industrial Engineering program.

MISSION

The School of Engineering of Beirut (ESIB) of the Saint Joseph University is a French-speaking engineering institution dedicated to higher education and research, serving Lebanon and the wider region. ESIB provides students with a robust education to acquire high-level scientific and technical skills in several areas of the engineering profession, allowing them to become operational both in design and research as well as on site and in industry. The academic experience of the students goes beyond the acquisition of knowledge in the courses to skill-based learning involving creativity, innovation, cooperation, collaboration with peers and tolerance.

ADMINISTRATION

Dean: Wassim RAPHAEL

Heads of Department:

Department of Preparatory Classes: Melhem EL HELOU
Department of Civil Engineering and Environment: Muhsin Elie RAHHAL
Department of Electrical and Mechanical Engineering: Flavia KHATOUNIAN EL RAJJI
Department of Chemical and Petrochemical Engineering: Jihane RAHBANY EL MOUNSEF

Department of Doctoral Studies: Ragi GHOSN
Center for Electrical Industries and Telecommunications: Elias RACHID
Center for Computer Science, Modeling and Information Technology: Rayan MINA
Lebanese Center for Construction Studies and Research: Fouad KADDAH
Wajdi Najem Regional Center for Water and the Environment:

ADMINISTRATIVE STAFF

Dean's office:
Assistant to the Dean: Ghada AOUAD, Rita-Maria AZAR TANNOUS
Executive Assistants: Rose DAGHER MRAD, Tatiana JABBOUR, Elyse SALIBA
Supervisor: Jihad KHAWAND
Employee: Joyce CHEHADE

Department of Preparatory Classes:
Executive Assistants: Cynthia KHAYRALLAH, Grace MAALOUF

Department of Civil Engineering and Environment:
Executive Assistant: Lina HANY AZAR

Department of Electrical and Mechanical Engineering:
Executive Assistant: Lynn SADER

Department of Chemical and Petrochemical Engineering:
Executive Assistant: Zeina SAWAYA BOUEIZ

Department of Doctoral Studies and Department:
Executive Assistant: Zeina SAWAYA BOUEIZ
Coordinator of the Master in Road Safety Management: Marguerita MOUAWAD

Center for Electrical Industries and Telecommunications:
Michel MOUGHABGHAB, head of the Electromechanical Unit

Center for Computer Science, Modeling and Information Technology:
Carine BOUSTANY SAWAYA, Programmer

Lebanese Center for Construction Studies and Research:
Executive Assistant: Zeina SAWAYA BOUEIZ
Lab Technician: Charbel AOUN,

Wajdi Najem Regional Center for Water and the Environment:
Lab Assistant: Elie KHACHO

FACULTY

Professors:

Maroun CHAMOUN, Rémi Ziad DAOU, Fadi GEARA, Ragi GHOSN, Marc IBRAHIM, Fouad KADDAH, Hadi KANAAN, Flavia KHATOUNIAN, Rima KILANY CHAMOUN, Dany MEZHER, Toni NICOLAS, Elias RACHID, Muhsin Elie RAHHAL, Wassim RAPHAEL, Hadi SAWAYA.

Associate Professors:

Alain AJAMI, Nancy CHALHOUB, Georges CHAMOUN, Melhem EL HELOU, Rafic FADDOUL, Fares MAALOUF, Chantal MAATOUK, Rayan MINA, Jihane RAHBANY (EL) MOUNSEF, Renalda SAMRA (AL) KHALIL, Chantal SAAD HAJJAR, Ali (AL) SHAER, Sami YOUSSEF.

Assistant Professors:

Pascal ABBOUD, Cynthia ANDRAOS, Youssef BAKOUNY, Nadine BEJJANI, Marina DACCACHE, Rim DBAISSY, Khalil HARISS, Ali HARKOUS, Farah HOMSI, Joseph KESERWANY, Gabriel KHOURY, Malek MSHEIK, Katia RAYA, Guilnard SADAKA, Melissa SAID, Wafa SAOUD, Jean SAWMA, Tina YAACOUB.

Lecturers:

Juliana EL RAYESS, Maria HABIB.

Instructors:

Nadine ABBAS, Jack ABDO, Joanna ABDOU NADER, Roy ABI ZEID DAOU, Naji ABOU ASSALY, Adel ABOU JAOUDÉ, Joanna ABOU JAOUDÉ, Abdallah ABOU RAHHAL, Marc ABOU RJEILI, Georges ABOU SLEIMAN, Hani AGHAR, Nancy ALAM CHOUCAIR, Elie AOUAD, Angèle AOUAD RIZK, Nathalie AOUAD ROUHAYEM, Khattar ASSAF, Ortanse ATTARIAN JABRE, Ahmad AUDI, Zeina AWADA, Soumaya AYADI MAASRI, Maroun AYLI, Rita AZZI, Jean-Marie BACHA, Hilda BAIRAMIAN, Mounia BEDRAN, Danielle BEDROSSIAN, Nabil BEJJANI, Elie BOU CHAKRA, Maroun BOULOS, Nathalie CHAHINE, Raymond CHAKHTOURA, Carla CHAMOUN, Dima CHEBIB, Saïd CHEHAB, Saleh CHEHADE, Aida CHEIKH, André CHKAIBANE, Esber CHOUEIRY, Nadim CHOUEIRY, Joseph CONSTANTIN, Ibtissam CONSTANTIN KIWAN, Adham DIMASHKI, Joelle FADDOUL, Toufic FAKHRY, Fady FARAH, Joseph FARES, Robert FARHA, Mohamad FARHAT, Hussein FARROUKH, Antoine FÉGHALY, Christelle GEARA, Shawki GHARIB, Nada GHORRA CHÉHADÉ, Bassam HABRE, Ghassan HACHEM, Naji HACHEM, Rania HACHEM SAAD, Georges HADDAD, Ronald HAGE, Antoine HAGE, Ahmad HAJJ, Ali HAJJ HASSAN, Wassim HAJJAR, Massaad HAKIM, Ziad HAKIM RAHMÉ, Najib HARB, Roy HARB, Elias HELOU, Rouba HELOU SARKIS, Nabil HENNAOUI, Nadim HENOUD, Alaa HIJAZI, Houssam HIJAZI, Rayan HIJAZI, Elie HLEIHEL, Jihad (EL) HOKAYEM, Mary (EL) HOKAYEM, Najate (EL) HOKAYEM, Antoine HREICHE, Eliane IBRAHIM, Lina ISKANDAR HAWAT, Cyril JABRA, Georges JAMAL, Samar KADDAH, André KANAAN, Tala KANSON, Jean-Michel KAOUKABANI, Firas KHALIFE, Walid KHALIL, Tony KHALIL, Marina KHOURY, Grace (EL) KHOURY, Ibrahim KIWAN, Joseph KOZEILY, Elie MAALOUF, Hiam MALLAT, Johny MATAR, Roger MATTA, Rodolphe MATTAR, Joseph MCHAYLEH, Hassan MCHEIK, Elias MECHREF, Rabih MOAWAD, Alfred MORCOS HAYEK, Fouad MOTI, Charbel MOUAWAD, Carole MOUKAWAM DIB, Cynthia MOUSSA, Manal MOUSSALLEM, Malek MSHEIK, Bassel NASR, Nassib NASR, Bassam NASRALLAH, Danielle NASRALLAH, Zulfiqar NASSER AL DEEN, Rana NASSIF, Georges NAWFAL, Faten NAZZAL, Hiam NEHMÉ, Rawad NICOLAS ASSAF, Joanna NSEIR, Elie RAHMÉ, Ahmad RAMMAL, Georges REAIDY, Elie RENNO, Bassam RIACHI, Alexandre RICHA, Nicolas ROUHANA, Nour ROUMIEH, Kamal SAFA, Yara SAFI, Georges SALLOUM, Caline SAMAHA MAHBOUB, Abed Ellatif SAMHAT, Ibrahim SAMMOUR, Nour SARDOUK, Maria SAROUFIM, Joseph Mary SARROUH, Antoine SAWAYA, Jinane SAYAH, Graziella SEBAALY, Vahe SEFERIAN, Marlène SEIF AOUAD, Saad SFEIR, Ahmad TABIKH, Yehia TAHER, Anthony TANNOURY, Fadia TAWIL KARAM, Mansour TAWK, Martine TOHMÉ, Naji WAK, Claude WEHBÉ CHALHOUB, Georges YARACK, Jean-Yves YOUSSEF, Marie-José ZACCA, Christiana ZARAKET, Elie ZEIDAN, Élise ZGHEIB.

Faculty members of another USJ institution:

Maher ABBOUD, Nancy ALLAM CHOUCAIR, Nizar ATRISSI, Hayat AZOURI TANNOUS, Joseph BEJJANI, Ursula EL HAGE, Roger LTEIF, Dominique SALAMEH.

Visiting Professors:

Said BITAR, Claude BOCQUILLON, Maurice FADEL, Hussein IBRAHIM, Eric MONMASSON, Nicolas PATIN.

DEGREES, DIPLOMAS AND CERTIFICATES AWARDED

- Bachelor of Engineering in Chemical and Petrochemical Engineering
- Bachelor of Engineering in Civil Engineering, concentrations:
  - Buildings and Engineering Management
  - Public Works and Transportation
  - Water and Environment
- Bachelor of Engineering in Computer and Communications Engineering, concentrations:
  - Artificial Intelligence
  - Software Engineering
  - Telecommunication Networks
- Bachelor of Engineering in Electrical Engineering
- Bachelor of Engineering in Industrial Engineering
- Bachelor of Engineering in Mechanical Engineering
  - Mechatronics
  - Energy
  - Mechanical design

- Master in Artificial Intelligence
- Master in Data Science
- Master in Electrical and Electronic Engineering
- Master in Oil and Gas: Exploration, Production and Management (Upstream and Downstream)
- Master in Renewable Energy
- Master in Road Safety Management (MANSER)
- Master in Soil Structures and Mechanics
- Master in Telecommunications, Networks and Security
- Master in Water Sciences
- PhD in Civil, Water and Environmental Engineering
- PhD in Computer and Telecommunications Engineering
- PhD in Electrical and Energy Engineering
- University Diploma in Artificial Intelligence
- University Diploma in Web Development and Cybersecurity

JOB OPPORTUNITIES

Bachelor of Engineering in Chemical and Petrochemical Engineering
Graduates work in companies from major sectors of:
- Chemistry
- Biotechnology
- Pharmacy
- Energy
- Environment
- Petrol and gas, and more generally material processing industries (glass, cement, paper, textile, paint, cosmetics, agri-food industries, etc.).

Bachelor of Engineering in Civil Engineering
Graduates can work in all sectors of civil engineering and construction:
- Company engineering
- Buildings
- Public works
- Works of art, geotechnical
- Structures
- Maritime works
- Airports
- Dams
- Water and waste treatment
- Teaching and research

Bachelor of Engineering in Computer and Communications Engineering
Graduates work in companies from major sectors of:
- Digital service companies
- Software publishers
- Telecommunications operators: service operators and network operators
- Integrators of networks and business communication systems
- Equipment manufacturers specializing in electronics and telecommunications
- Technological startups
- Consulting firms and design offices
- Companies in the banking and insurance sector
- Companies in the home automation sector
- Companies in the robotics sector
- Teaching and research

Bachelor of Engineering in Electrical Engineering
Graduates work in companies from major sectors of:

- Consulting and design
- Home automation
- Robotics
- Electrical networks: production, conversion, transport and distribution of electrical energy
- Electrification
- Industry
- Banking and insurance
- Management
- Teaching and research
- Technological startups

Bachelor of Engineering in Industrial Engineering
Graduates work in companies from major sectors of:

- Consulting
- Project management
- Manufacturing
- Production chain, stock
- Business, economy, finance and banking
- Optimization, quality and sustainability
- Management
- Teaching and research

Bachelor of Engineering in Mechanical Engineering
Graduates work in companies from major sectors of:

- Production and distribution of goods
- Design, construction, monitoring, maintenance of mechanical systems
- Steel industry
- Automotive
- Control and automation
- Biomedical and biomaterials
- Aeronautics (exchange program with ISAE-SUPAERO Toulouse)
- Heating, air conditioning and plumbing
- Energy production and conversion
- Air conditioning and refrigeration
- Renewable Energies

TUITION FEES

Tuition fees are set at the start of the year, and payable in two installments for each semester of the year. Tuition fees amount to : 188 Fresh US Dollars and 7 209 000 Lebanese Pounds (for semester 1), equivalent in Fresh US Dollars to 268 (exchange rate = 89,500 LBP) per credit in preparatory engineering courses and major engineering courses, i.e., $8,040 for 30 credits. To address their financial difficulties, students can contact the USJ Financial Aid Office. If their application is accepted, they may receive a study grant or a loan. To download the financial aid application form, visit: www.usj.edu.lb/servicesocial/.

SPECIFIC PROVISIONS OF THE INTERNAL REGULATIONS OF STUDY

Title Seven – Articles Specific to ESIB

Article 2.d – bis

To obtain an engineering degree from ESIB, students must complete a minimum of 10 regular semesters (4 semesters of preparatory classes and 6 semesters of major engineering classes).

Article 2.e – bis

At ESIB, students may register for a maximum of 18 credits during the summer trimester.
At ESIB, students on probation (see Article 54) may not register for more than 24 credits per semester.
Similarly, "anticipatory registration" (see Article 16) in the engineering cycle is possible (i.e., a student who still has not validated all the credits of the preparatory classes); however, the student may not register for more than 24 credits. In this case, enrollment in the preparatory classes is compulsory and has priority, as long as these courses are offered throughout the semester in question.

Article 2.f – bis

At ESIB, the maximum duration of studies is of 8 semesters for the preparatory classes and 12 semesters for the major engineering classes. A student who has not validated all the preparatory classes (120 credits) at the end of 8 regular semesters may no longer pursue their studies. Similarly, a student who has not validated all the major engineering classes (180 credits) after 12 regular semesters is no longer eligible for the Bachelor of Engineering diploma.

Article 3.f – bis

At ESIB, preparatory classes consist of 120 credits (4 semesters) and major engineering classes of 180 credits (6 semesters).
To obtain a Master from ESIB, students in the major engineering classes must validate at least 18 credits (Master with a research dissertation) or at least 24 credits (Master with a project or internship), along with 30 credits for a dissertation, project or internship.

Article 3.f – bis

Course type	Number of credits suggested by the institution	Number of credits the student should validate	For the ESIB Bachelor of Engineering
Required courses	At least 126[1]	Credits required by the institution	Between 210 and 270 credits
Closed electives	At least 18	At least 26	At least 26
Open electives	List suggested by the institution	At least 6	At least 6

Article 4 – bis

At ESIB, to register and complete the final project of the engineering programs (16 credits), students must have validated at least 150 credits of the major engineering classes.

Article 16 – bis

At ESIB, Article 16 applies to students who pass from the preparatory classes to the major engineering classes.
When 16 or fewer credits are required to complete the preparatory classes, "anticipatory registration" for the major engineering classes is possible for a maximum of 24 credits per semester (including the preparatory class credits), upon the approval of the Institution Board. This requires the favorable opinion of the tutor, the agreement of the Head of the preparatory classes department and that of the Head of the engineering department in question.

Article 27.a – bis

There is no second session at ESIB, due to program evaluation requirements.

Article 28.b – bis

At ESIB, any student who is absent for an assessment may repeat the assessment if the excuse they provide is deemed valid by the administration.

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[1] *This number represents 70% of the total number of credits pertaining to compulsory courses in the first cycle, which is generally of 180 ECTS credits.*

Article 34.d – bis

At ESIB, midterm exams and periodic assessments are not anonymous.

Article 50: *Passing a Course*

To pass a course, students must obtain an average of 10/20. When the course is a project, an internship or practical work, the average is 12/20.

Article 51: *Graduation*

To obtain the Bachelor of Engineering diploma, the student must pass all the compulsory courses of both the preparatory classes and the major engineering classes and must:

i. Meet the conditions for a sufficient command of the Arabic and English languages (Article 6 – paragraphs c and d);
ii. Validate the 120 credits of the preparatory classes;
iii. Validate the 180 credits of the major engineering classes;
iv. Have a cumulative average of 12/20 or more in the major engineering classes.

Article 52: *Repeating a Compulsory Course*

If a student fails a compulsory course, they must register for it as soon as the course is offered again.

Article 53: *Cumulative Average*

The cumulative average is calculated at the end of each semester; it represents the weighted average of all the student's grades in the corresponding cycle. In the case of a repeated course, the most recent grade is used.

Article 54: *Probation*

A student in the preparatory class is placed on probation if:

i. at the end of the first year (including the summer trimester), their cumulative average is less than 10/20.
ii. at the end of the second year (including the summer trimester), their cumulative average is less than 10/20.
iii. they fail the same course* twice in a row.

A preparatory class student who enrolls at ESIB in the second semester of the first year is placed on probation if:

iv. at the end of the first year of study (including the summer trimester), their cumulative average is less than 10/20. That is, at the end of the regular semester 3 of the preparatory classes.
v. they fail the same course* twice in a row.

A major engineering class student is placed on probation if:

vi. at the end of the first year, their cumulative average is less than 11.50/20.
vii. for subsequent semesters, their cumulative average at the end of the semester is less than 12.00/20.
viii. they fail the same course* twice in a row.

A student is no longer considered to be on probation unless, at the end of a semester, they have met the requirements of that semester for not being on probation.

*If a student is on probation because they have failed the same course twice, they do not come off probation until they have passed the course.

HONORS PREPARATORY IN CHEMICAL AND PETROCHEMICAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The objectives of the Chemical and Petrochemical Engineering program are to equip students to:

- Pursue successful professional careers by skillfully solving emerging engineering problems.
- Contribute to the sustainable growth and development of the society.
- Sustain intellectual curiosity and further expand their knowledge and skills allowing them to assimilate the advances in the profession in a changing world.
- Assume leadership roles while respecting diversity and ethical practices.

Program Learning Outcomes (Competencies)

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

Program Requirements

120 credits: Required courses (120 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 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.).

Sciences (54 Cr.): Advanced General Chemistry (4 Cr.), Electromagnetism (4 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Inorganic Chemistry and Laboratory (2 Cr.), Magnetic Induction (2 Cr.), Mechanics 1 (6 Cr.), Mechanics 2 (4 Cr.), Organic Chemistry and Laboratory (2 Cr.), Physical Signals (6 Cr.), Physics Laboratory 1 (2 Cr.), Physics Laboratory 2 (2 Cr.), Quantum Physics (2 Cr.), Signal Processing (2 Cr.), Thermodynamics 1 (6 Cr.), Thermodynamics 2 (2 Cr.), Wave Optics (2 Cr.).
Programming (10 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (2 Cr.).
Engineering Fundamentals (6 Cr.): Geology (2 Cr.), Introduction to Fluid Mechanics (2 Cr.), Supervised Personal Initiative Work (2 Cr.).
Humanities (8 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.).

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Chemical and Petrochemical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
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

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 1	6
020SPHCI1	Physical Signals	6
	Total	**30**

Semester 2

Code	Course Name	Credits
020AL1CI2	Algebra 1	6
020AA1CI2	Analysis 1	4
020FR1CI2	French and Philosophy 1	2
020TCGCI2	General Chemistry Laboratory	2
020INMCI2	Magnetic Induction	2
020PP1CI2	Physics Laboratory 1	2
020IF1CI2	Programming 1	4

020TH1CI2	Thermodynamics 1	6
	Total	**28**

Semester 3

Code	Course Name	Credits
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**

Semester 4

Code	Course Name	Credits
020AL3CI4	Algebra 3	4
020AN3CI4	Analysis 3	4
020GELCI4	Geology	2
020CIOCI4	Inorganic Chemistry and Laboratory	2
020IMFCI4	Introduction to Fluid Mechanics	2
020CORCI4	Organic Chemistry and Laboratory	2
020IF3CI4	Programming 3	2
020PHQCI4	Quantum Physics	2
020TIPCI4	Supervised Personal Initiative Work	2
020TH2CI4	Thermodynamics 2	2
064VALEL1	USJ Values in Daily Life	2
	Total	**26**

Course description

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; Characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. Optimization of a chemical process; Overvoltage: Current-potential curves; Spontaneous transformations; Batteries and electrolyzers; Mixed potential, Corrosion potential, Corrosion current intensity, Uniform corrosion in 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.
Algebraic structures, vector spaces, linear applications, matrices, determinants, linear systems, euclidean spaces.

020AL2CI3 Algebra 2 6 Cr.
This course, a continuation of Algebra 1, explores the advanced study of algebraic structures such as groups, rings, and fields. It includes a detailed examination of endomorphisms, matrix reduction, and special substructures of algebraic structures like ideals. Topics explored include classification of matrices, the computation of eigenvalues and equivalent matrices. With a mix of theoretical understanding and practical applications, students will gain a comprehensive understanding of these mathematical concepts.
Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.
Algebra 3 is an advanced course, divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 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.
Asymptotic analysis: Taylor series- Integration on a segment: integration and derivation- Riemann's sum- Real and complex series, series with positive terms, convergence and absolute convergence- Combinatorics: Cartesian product, arrangements, combinations, finite sets cardinality, probability on a finite space, Bayes formula, independence, finite random variables.

020AN2CI3 Analysis 2 6 Cr.
Normed vector spaces: continuity, uniform continuity and Lipchitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, line integrals.
Prerequisite: Analysis 1 (020AA1CI2).

020AN3CI4 Analysis 3 4 Cr.
Series and summable families, sequences and series of functions, integration and derivation of a series of functions, power aeries, probability and discrete random variables, linear

differential equation and systems of the form X'=A(t)X+B(t), method of the constant variation, Lagrange's method.
Prerequisite: Analysis 2 (020AN2CI3)

020MADCI1 Discrete Mathematics 6 Cr.
Logic and reasoning, Set theory, Applications, Binary relations, Algebraic calculations, Complex numbers, Integer arithmetic, Polynomials.

020EMECI3 Electromagnetism 4 Cr.
This course starts with a separate study in the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is focused on the propagation of EM waves in vacuum, in conductors, in plasma and far away form 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) in order 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.

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020ANGCI1 General Analysis 6 Cr.
Set of real numbers, real functions, trigonometric functions, logarithmic functions, power functions, inverse trigonometric functions, hyperbolic functions, linear first order differential equations, second order differential equations with constant coefficients, real and complex sequences, limits and continuity of real functions, differentiability, Roll's Theorem, applications.

020CHGCI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students also learn the concept of heterogeneous equilibrium in 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 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. Emphasis will be placed on familiarizing students with the equipment used in each laboratory session and establishing a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGCI1).

020GELCI4 Geology 2 Cr.

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

020CIOCI4 Inorganic Chemistry and Laboratory 2 Cr.

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

020IMFCI4 Introduction to Fluid Mechanics 2 Cr.

Fluid properties, Hydrostatic Law, Pascal Law, Archimedes Law, Hydrostatic force on plane and curved surfaces. Lines of flow, Types of flow, velocity field and acceleration, continuity equation, Equation of streamline, stream function, velocity potential function, circulation, vorticity, irrotational and rotational flow, compressible and incompressible flows, Lagrange and Euler Description.

020INMCI2 Magnetic Induction 2 Cr.

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

020MC1CI1 Mechanics 1 6 Cr.

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

020MC2CI3 Mechanics 2 4 Cr.

The course of Mechanics 2 focuses on the study of specific topics within the field of classical mechanics. Its primary objective is to provide students with a deeper understanding of non-inertial reference frames, friction phenomena, and solid rotation around a fixed axis. In the realm of non-inertial reference frames, students explore the principles and equations necessary to analyze and solve problems involving accelerated systems. They learn to account for the effects of fictitious forces, such as centrifugal and Coriolis forces, which arise in non-inertial frames. The course also delves into the intricate nature of friction, examining its various types and the factors affecting its magnitude. Students acquire the skills to analyze the behavior of objects subject to both static and kinetic friction. Lastly, the study of solid rotation around a fixed axis enables students to comprehend the kinematics and dynamics of rotating bodies, including concepts like angular velocity, angular acceleration, and moments of inertia. Overall, the course of Mechanics 2 equips students with the fundamental knowledge and problem-solving abilities necessary to tackle complex mechanical systems involving non-inertial reference frames, frictional forces, and solid rotation.
Prerequisite: Mechanics 1 (020MC1CI1)

020CORCI4 Organic Chemistry and Laboratory 2 Cr.

This course begins with an introduction to organic chemistry, naming of organic molecules and their spatial representation. It enables students to master stereoisomerism and the reactivity of molecules: inductive and mesomeric effects, nucleohilic and electrophilic reagents. Then the reaction in organic chemistry is explained and the following organic compounds are studied: halogenated derivatives –alkenes and alkynes – benzene and aromatic compounds – Alcohols (substitution, elimination, oxidation) – carbonyl compounds (substitution on the acyl group) –

reactions of aldehydes and ketones – Carboxylic acids, esters, amides and amines. After each part addressed, tutorials are treated in order to master the concept. Practical works are also conducted to let students master the methods of extraction filtration, purification and synthesis of organic products.

020SPHCI1 Physical Signals 6 Cr.

The course is concerned with a wide range of concepts already introduced at high school: periodic signals, spectrums, electrical energy, Ohm's law, Joule's law, lenses, 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, focometry and Optical Systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts

020PP2CI3 Physics Laboratory 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.
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 programing – 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 quantification. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.
This course aims to provide students with a thorough understanding of key concepts related to filtering of periodic signals and sampling. Students will have the opportunity to deepen their knowledge of linear filters, understanding their operation and exploring the effects of first and second-order filters on a periodic signal. Special attention will be given to the sampling process, with a detailed study of the Nyquist-Shannon theorem, which establishes the necessary conditions to avoid spectrum folding. Additionally, students will have the opportunity to become familiar with digital filtering
Prerequisite: Physical Signals (020SPHCI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.
In this course students undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.
The student's work revolves around concrete research, analyzing reality to identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 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.

The objective of this course is to master and apply the concepts and fundamental principles of thermodynamics. It aims to develop the ability to solve practical problems using energy, mass, and entropy balances. Indeed, energy in all its forms is studied in various machines, such as internal combustion engines, turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems, which require a command of powerful tools (Laplacian, divergence) in concrete situations. The student becomes familiar with partial differential equations and learns 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 diffraction grating
Prerequisite: Physical Signals (020SPHCI1).

HONORS PREPARATORY IN CIVIL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

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

- Work effectively and ethically in their professional environment at local, regional and international levels.
- Advance in their careers to become leaders in their profession, through trilingual skills, life-long learning and creativity.
- Lead in a dynamic professional environment through continuous learning and development of knowledge and skills.

Program Learning Outcomes (Competencies)

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

Program Requirements

120 credits: Required courses (120 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 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.).

Sciences (52 Cr.): Advanced General Chemistry (4 Cr.), Electromagnetism (4 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Introduction to Fluid Mechanics (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 (10 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (2 Cr.).
Engineering Fundamentals (8 Cr.): Geology (2 Cr.), Statics (2 Cr.), Supervised Personal Initiative Work (2 Cr.), Topography (2 Cr.).
Humanities (8 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.).

USJ General Education Program (10/40 Cr.)

30 additional credits are earned at the Department of Civil Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
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

Suggested Study Plan

Semester 1

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

Semester 2

Code	Course Name	Credits
020AL1CI2	Algebra 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**

Semester 3

Code	**Course Name**	**Credits**
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**

Semester 4

Code	**Course Name**	**Credits**
020AL3CI4	Algebra 3	4
020AN3CI4	Analysis 3	4
020IMFCI4	Introduction to Fluid Mechanics	2
020STACI4	Statics	2
020IF3CI4	Programming 3	2
020PHQCI4	Quantum Physics	2
020TIPCI4	Supervised Personal Initiative Work	2
020TOGCI4	Topography	2
020GELCI4	Geology	2
020TH2CI4	Thermodynamics 2	2
064VALEL1	USJ Values in Daily Life	2
	Total	**26**

Course description

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; Characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. Optimization of a chemical process; Overvoltage: Current-potential curves; Spontaneous transformations; Batteries and electrolyzers; Mixed potential, Corrosion

potential, Corrosion current intensity, Uniform corrosion in 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.
Algebraic structures, vector spaces, linear applications, matrices, determinants, linear systems, euclidean spaces.

020AL2CI3 Algebra 2 6 Cr.
This course, a continuation of Algebra 1, explores the advanced study of algebraic structures such as groups, rings, and fields. It includes a detailed examination of endomorphisms, matrix reduction, and special substructures of algebraic structures like ideals. Topics explored include classification of matrices, the computation of eigenvalues and equivalent matrices. With a mix of theoretical understanding and practical applications, students will gain a comprehensive understanding of these mathematical concepts.
Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.
Algebra 3 is an advanced course, divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 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.
Asymptotic analysis: Taylor series- Integration on a segment: integration and derivation- Riemann's sum- Real and complex series, series with positive terms, convergence and absolute convergence- Combinatorics: Cartesian product, arrangements, combinations, finite sets cardinality, probability on a finite space, Bayes formula, independence, finite random variables.

020AN2CI3 Analysis 2 6 Cr.
Normed vector spaces: continuity, uniform continuity and Lipchitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, line integrals.
Prerequisite: Analysis 1 (020AA1CI2).

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Series and summable families, sequences and series of functions, integration and derivation of a series of functions, power aeries, probability and discrete random variables, linear differential equation and systems of the form X'=A(t)X+B(t), method of the constant variation, Lagrange's method.
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Logic and reasoning, Set theory, Applications, Binary relations, Algebraic calculations, Complex numbers, Integer arithmetic, Polynomials.

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Prerequisite: Mechanics 1 (020MC1CI1)

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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.

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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.

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 programing – 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 quantification. The second is an introduction to statistical thermodynamics where macroscopic

properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.
This course aims to provide students with a thorough understanding of key concepts related to filtering of periodic signals and sampling. Students will have the opportunity to deepen their knowledge of linear filters, understanding their operation and exploring the effects of first and second-order filters on a periodic signal. Special attention will be given to the sampling process, with a detailed study of the Nyquist-Shannon theorem, which establishes the necessary conditions to avoid spectrum folding. Additionally, students will have the opportunity to become familiar with digital filtering
Prerequisite: Physical Signals (020SPHCI1).

020STACI4 Statics 2 Cr.
Statics is an introduction to learning and applying the principles required to solve engineering problems. Concepts will be applied in this course from previous courses taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. The purpose of this course is to study methods for quantifying the forces between bodies and defining their equilibrium. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Motion and changes in shape are critical to the functionality of objects and structure. Statics is an essential prerequisite for many branches of engineering, such as civil engineering and mechanical engineering, which address the various consequences of forces
Prerequisite: Mechanics 1 (020MC1CI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.
In this course students undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.
The student's work revolves around concrete research, analyzing reality to identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 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.

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

020TOGCI4 Topography 2 Cr.

The goal 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 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 diffraction grating
Prerequisite: Physical Signals (020SPHCI1).

HONORS PREPARATORY IN COMPUTER AND COMMUNICATIONS ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The objectives of the Computer and Communications Engineering program are to equip students to:

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

Program Learning Outcomes (Competencies)

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

Program Requirements

120 credits: Required courses (120 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 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.).
Sciences (48 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.), Thermodynamics 1 (6 Cr.), Thermodynamics 2 (2 Cr.), Wave Optics (2 Cr.).
Programming (10 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (2 Cr.).
Engineering Fundamentals (12 Cr.): Digital Systems Design (4 Cr.), Linear Electrical Systems and Networks (4 Cr.), Signal Processing (2 Cr.), Supervised Personal Initiative Work (2 Cr.).
Humanities (8 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.).

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
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

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 1	6
020SPHCI1	Physical Signals	6
	Total	**30**

Semester 2

Code	Course Name	Credits
020AL1CI2	Algebra 1	6
020AA1CI2	Analysis 1	4
020FR1CI2	French and Philosophy 1	2
020TCGCI2	General Chemistry Laboratory	2
020INMCI2	Magnetic Induction	2
020PP1CI2	Physics Laboratory 1	2
020IF1CI2	Programming 1	4
020TH1CI2	Thermodynamics 1	6
	Total	**28**

Semester 3

Code	Course Name	Credits
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**

Semester 4

Code	Course Name	Credits
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**

Course description

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; Characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. Optimization of a chemical process; Overvoltage: Current-potential curves; Spontaneous transformations; Batteries and electrolyzers; Mixed potential, Corrosion potential, Corrosion current intensity, Uniform corrosion in 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.

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

020AL2CI3 Algebra 2 6 Cr.

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

Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.

Algebra 3 is an advanced course, divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 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.

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

020AN2CI3 Analysis 2 6 Cr.

Normed vector spaces: continuity, uniform continuity and Lipchitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, line integrals.

Prerequisite: Analysis 1 (020AA1CI2).

020AN3CI4 Analysis 3 4 Cr.

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

Prerequisite: Analysis 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.

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

020EMECI3 Electromagnetism 4 Cr.

This course starts with a separate study in the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is focused on the propagation of EM waves in vacuum, in conductors, in plasma and far away form 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) in order 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) in order 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.

Set of real numbers, real functions, trigonometric functions, logarithmic functions, power functions, inverse trigonometric functions, hyperbolic functions, linear first order differential equations, second order differential equations with constant coefficients, real and complex sequences, limits and continuity of real functions, differentiability, Roll's Theorem, applications.

020CHGCI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students also learn the concept of heterogeneous equilibrium in 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 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. Emphasis will be placed on familiarizing students with the equipment used in each laboratory session and establishing a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGCI1).

020SRLCI4 Linear Electrical Systems and Networks 4 Cr.

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

020INMCI2 Magnetic Induction 2 Cr.

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

020MC1CI1 Mechanics 1 6 Cr.

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

020MC2CI3 Mechanics 2 4 Cr.

The course of Mechanics 2 focuses on the study of specific topics within the field of classical mechanics. Its primary objective is to provide students with a deeper understanding of non-inertial reference frames, friction phenomena, and solid rotation around a fixed axis. In the realm of non-inertial reference frames, students explore the principles and equations necessary to analyze and solve problems involving accelerated systems. They learn to account for the effects of fictitious forces, such as centrifugal and Coriolis forces, which arise in non-inertial frames. The course also delves into the intricate nature of friction, examining its various types and the factors affecting its magnitude. Students acquire the skills to analyze the behavior of objects subject to both static and kinetic friction. Lastly, the study of solid rotation around a fixed axis enables students to comprehend the kinematics and dynamics of rotating bodies, including concepts like angular velocity, angular acceleration, and moments of inertia. Overall, the course of Mechanics 2 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, focometry and Optical Systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts

020PP2CI3 Physics Laboratory 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.

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 programing – 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 quantification. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.

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

Prerequisite: Physical Signals (020SPHCI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.

In this course students undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.

The student's work revolves around concrete research, analyzing reality to identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 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.

The objective of this course is to master and apply the concepts and fundamental principles of thermodynamics. It aims to develop the ability to solve practical problems using energy, mass, and entropy balances. Indeed, energy in all its forms is studied in various machines, such as internal combustion engines, turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems, which require a command of powerful tools (Laplacian, divergence) in concrete situations. The student becomes familiar with partial differential equations and learns 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 diffraction grating
Prerequisite: Physical Signals (020SPHCI1).

HONORS PREPARATORY IN ELECTRICAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

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

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

Program Learning Outcomes (Competencies)

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

Program Requirements

120 credits: Required courses (120 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 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.).
Sciences (50 Cr.): Advanced General Chemistry (4 Cr.), Electromagnetism (4 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Magnetic Induction (2 Cr.), Mechanics 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 (10 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (2 Cr.).
Engineering Fundamentals (10 Cr.): Digital Systems Design (4 Cr.), Linear Electrical Systems and Networks (4 Cr.), Supervised Personal Initiative Work (2 Cr.).
Humanities (8 Cr.): Engineering at the Service of the Community (2 Cr.), French and Philosophy 1 (2 Cr.), French and Philosophy 2 (2 Cr.), USJ Values in Daily Life (2 Cr.).

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
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

Suggested Study Plan

Semester 1

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

Semester 2

Code	Course Name	Credits
020AL1CI2	Algebra 1	6
020AA1CI2	Analysis 1	4
020FR1CI2	French and Philosophy 1	2
020TCGCI2	General Chemistry Laboratory	2
020INMCI2	Magnetic Induction	2
020PP1CI2	Physics Laboratory 1	2
020IF1CI2	Programming 1	4
020TH1CI2	Thermodynamics 1	6
	Total	**28**

Semester 3

Code	Course Name	Credits
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**

Semester 4

Code	Course Name	Credits
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**

Course description

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; Characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. Optimization of a chemical process; Overvoltage: Current-potential curves; Spontaneous transformations; Batteries and electrolyzers; Mixed potential, Corrosion potential, Corrosion current intensity, Uniform corrosion in 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.

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

020AL2CI3 Algebra 2 6 Cr.

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

Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.

Algebra 3 is an advanced course, divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 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.

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

020AN2CI3 Analysis 2 6 Cr.

Normed vector spaces: continuity, uniform continuity and Lipchitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, line integrals.

Prerequisite: Analysis 1 (020AA1CI2).

020AN3CI4 Analysis 3 4 Cr.

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

Prerequisite: Analysis 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.

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

020EMECI3 Electromagnetism 4 Cr.

This course starts with a separate study in the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is focused on the propagation of EM waves in vacuum, in conductors, in plasma and far away form 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) in order 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.

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020ANGCI1 General Analysis 6 Cr.

Set of real numbers, real functions, trigonometric functions, logarithmic functions, power functions, inverse trigonometric functions, hyperbolic functions, linear first order differential equations, second order differential equations with constant coefficients, real and complex sequences, limits and continuity of real functions, differentiability, Roll's Theorem, applications.

020CHGCI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students also learn the concept of heterogeneous equilibrium in 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 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. Emphasis will be placed on familiarizing students with the equipment used in each laboratory session and establishing a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGCI1).

020SRLCI4 Linear Electrical Systems and Networks 4 Cr.

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

020INMCI2 Magnetic Induction 2 Cr.

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

020MC1CI1 Mechanics 1 6 Cr.

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

020MC2CI3 Mechanics 2 4 Cr.

The course of Mechanics 2 focuses on the study of specific topics within the field of classical mechanics. Its primary objective is to provide students with a deeper understanding of non-inertial reference frames, friction phenomena, and solid rotation around a fixed axis. In the realm of non-inertial reference frames, students explore the principles and equations necessary to analyze and solve problems involving accelerated systems. They learn to account for the effects of fictitious forces, such as centrifugal and Coriolis forces, which arise in non-inertial frames. The course also delves into the intricate nature of friction, examining its various types and the factors affecting its magnitude. Students acquire the skills to analyze the behavior of objects subject to both static and kinetic friction. Lastly, the study of solid rotation around a fixed axis enables students to comprehend the kinematics and dynamics of rotating bodies, including concepts like angular velocity, angular acceleration, and moments of inertia. Overall, the course of Mechanics 2 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, focometry and Optical Systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts

020PP2CI3 Physics Laboratory 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.

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 programing – 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 quantification. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.

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

Prerequisite: Physical Signals (020SPHCI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.

In this course students undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.

The student's work revolves around concrete research, analyzing reality to identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 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.

The objective of this course is to master and apply the concepts and fundamental principles of thermodynamics. It aims to develop the ability to solve practical problems using energy, mass, and entropy balances. Indeed, energy in all its forms is studied in various machines, such as internal combustion engines, turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems, which require a command of powerful tools (Laplacian, divergence) in concrete situations. The student becomes familiar with partial differential equations and learns 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 diffraction grating

Prerequisite: Physical Signals (020SPHCI1).

HONORS PREPARATORY IN INDUSTRIAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

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

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

Program Learning Outcomes (Competencies)

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

Program Requirements

120 credits: Required courses (120 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 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.).
Sciences (50 Cr.): Advanced General Chemistry (4 Cr.), Electromagnetism (4 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Magnetic Induction (2 Cr.), Mechanics 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 (10 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (2 Cr.).
Engineering Fundamentals (10 Cr.): Digital Systems Design (4 Cr.), Linear Electrical Systems and Networks (4 Cr.), Supervised Personal Initiative Work (2 Cr.).
Humanities (8 Cr.): Engineering at the Service of the Community (2 Cr.), French and Philosophy 1 (2 Cr.), French and Philosophy 2 (2 Cr.), USJ Values in Daily Life (2 Cr.).

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
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

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 1	6
020SPHCI1	Physical Signals	6
	Total	**30**

Semester 2

Code	Course Name	Credits
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**

Semester 3

Code	Course Name	Credits

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**

Semester 4

Code	**Course Name**	**Credits**
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**

Course description

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; Characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. Optimization of a chemical process; Overvoltage: Current-potential curves; Spontaneous transformations; Batteries and electrolyzers; Mixed potential, Corrosion potential, Corrosion current intensity, Uniform corrosion in 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.

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

020AL2CI3 Algebra 2 6 Cr.
This course, a continuation of Algebra 1, explores the advanced study of algebraic structures such as groups, rings, and fields. It includes a detailed examination of endomorphisms, matrix reduction, and special substructures of algebraic structures like ideals. Topics explored include classification of matrices, the computation of eigenvalues and equivalent matrices. With a mix of theoretical understanding and practical applications, students will gain a comprehensive understanding of these mathematical concepts.
Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.
Algebra 3 is an advanced course, divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 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.
Asymptotic analysis: Taylor series- Integration on a segment: integration and derivation- Riemann's sum- Real and complex series, series with positive terms, convergence and absolute convergence- Combinatorics: Cartesian product, arrangements, combinations, finite sets cardinality, probability on a finite space, Bayes formula, independence, finite random variables.

020AN2CI3 Analysis 2 6 Cr.
Normed vector spaces: continuity, uniform continuity and Lipchitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, line integrals.
Prerequisite: Analysis 1 (020AA1CI2).

020AN3CI4 Analysis 3 4 Cr.
Series and summable families, sequences and series of functions, integration and derivation of a series of functions, power aeries, probability and discrete random variables, linear differential equation and systems of the form X'=A(t)X+B(t), method of the constant variation, Lagrange's method.
Prerequisite: Analysis 2 (020AN2CI3)

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Prerequisites: Physical Signals (020SPHCI1) - General Analysis (020ANGCI1).

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Prerequisite: Mechanics 1 (020MC1CI1)

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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.

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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).

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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.

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 programing – 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 quantification. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.

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

Prerequisite: Physical Signals (020SPHCI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.

In this course students undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.

The student's work revolves around concrete research, analyzing reality to identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 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.

The objective of this course is to master and apply the concepts and fundamental principles of thermodynamics. It aims to develop the ability to solve practical problems using energy, mass, and entropy balances. Indeed, energy in all its forms is studied in various machines, such as internal combustion engines, turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems, which require a command of powerful tools (Laplacian, divergence) in concrete situations. The student becomes familiar with partial differential equations and learns 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 diffraction grating

Prerequisite: Physical Signals (020SPHCI1).

HONORS PREPARATORY IN MECHANICAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

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 (120 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (120 Cr.)
Mathematics (42 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.).
Sciences (50 Cr.): Advanced General Chemistry (4 Cr.), Electromagnetism (4 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Magnetic Induction (2 Cr.), Mechanics 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 (10 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (2 Cr.).
Engineering Fundamentals (10 Cr.): Computer Assisted Drawing (2 Cr.), Linear Electrical Systems and Networks (4 Cr.), Statics for Mechanical Engineering (2 Cr.), Supervised Personal Initiative Work (2 Cr.).
Humanities (8 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.).

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
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

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 1	6
020SPHCI1	Physical Signals	6
	Total	**30**

Semester 2

Code	Course Name	Credits
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**

Semester 3

Code	Course Name	Credits
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**

Semester 4

Code	Course Name	Credits
020AL3CI4	Algebra 3	4
020AN3CI4	Analysis 3	4
020DISCI4	Computer Assisted Drawing	2
020SRLCI4	Linear Electrical Systems and Networks	4
020IF3CI4	Programming 3	2
020PHQCI4	Quantum Physics	2
020STMCI4	Statics for Mechanical Engineering	2
020TIPCI4	Supervised Personal Initiative Work	2
020TH2CI4	Thermodynamics 2	2
064VALEL1	USJ Values in Daily Lifee	2
	Total	**26**

Course description

020CHACI3 Advanced General Chemistry 4 Cr.

The overall aim of this course is to provide students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; Characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. Optimization of a chemical process; Overvoltage: Current-potential curves; Spontaneous transformations; Batteries and electrolyzers; Mixed potential, Corrosion potential, Corrosion current intensity, Uniform corrosion in 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.
Algebraic structures, vector spaces, linear applications, matrices, determinants, linear systems, euclidean spaces.

020AL2CI3 Algebra 2 6 Cr.
This course, a continuation of Algebra 1, explores the advanced study of algebraic structures such as groups, rings, and fields. It includes a detailed examination of endomorphisms, matrix reduction, and special substructures of algebraic structures like ideals. Topics explored include classification of matrices, the computation of eigenvalues and equivalent matrices. With a mix of theoretical understanding and practical applications, students will gain a comprehensive understanding of these mathematical concepts.
Prerequisite: Algebra 1 (020AL1CI2).

020AL3CI4 Algebra 3 4 Cr.
Algebra 3 is an advanced course, divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 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.
Asymptotic analysis: Taylor series- Integration on a segment: integration and derivation- Riemann's sum- Real and complex series, series with positive terms, convergence and absolute convergence- Combinatorics: Cartesian product, arrangements, combinations, finite sets cardinality, probability on a finite space, Bayes formula, independence, finite random variables.

020AN2CI3 Analysis 2 6 Cr.
Normed vector spaces: continuity, uniform continuity and Lipchitz continuity, compactness, linear maps, path connectedness – Generalized integrals: tests of convergence, dominated convergence - Functions of several variables: directional and partial derivatives, differentiability, gradient, extrema of functions of several variables, differential forms, multiple integrals, line integrals.
Prerequisite: Analysis 1 (020AA1CI2).

020AN3CI4 Analysis 3 4 Cr.
Series and summable families, sequences and series of functions, integration and derivation of a series of functions, power aeries, probability and discrete random variables, linear

differential equation and systems of the form X'=A(t)X+B(t), method of the constant variation, Lagrange's method.
Prerequisite: Analysis 2 (020AN2CI3)

020DAMCI4 Computer Assisted Drawing 2 Cr.
Drawing on AutoCAD. Classification of drawings. Standardization. Presentation of drawings. Methods of executing a drawing. Geometric constructions. Connections. Common curves. Presentation of solids. Dimensioning. Cross-sections. Sections. Surface states. Tolerances and fits. Functional dimensioning. Assembly drawing. Modes of mechanical connections. Means of mechanical connections and technological elements. Symbolic representation.

020MADCI1 Discrete Mathematics 6 Cr.
Logic and reasoning, Set theory, Applications, Binary relations, Algebraic calculations, Complex numbers, Integer arithmetic, Polynomials.

020EMECI3 Electromagnetism 4 Cr.
This course starts with a separate study in the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is focused on the propagation of EM waves in vacuum, in conductors, in plasma and far away form 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) in order 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) in order 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.

Set of real numbers, real functions, trigonometric functions, logarithmic functions, power functions, inverse trigonometric functions, hyperbolic functions, linear first order differential equations, second order differential equations with constant coefficients, real and complex sequences, limits and continuity of real functions, differentiability, Roll's Theorem, applications.

020CHGCI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students also learn the concept of heterogeneous equilibrium in 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 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. Emphasis will be placed on familiarizing students with the equipment used in each laboratory session and establishing a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGCI1).

020SRLCI4 Linear Electrical Systems and Networks 4 Cr.

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

020INMCI2 Magnetic Induction 2 Cr.

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

020MC1CI1 Mechanics 1 6 Cr.

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

020MC2CI3 Mechanics 2 4 Cr.

The course of Mechanics 2 focuses on the study of specific topics within the field of classical mechanics. Its primary objective is to provide students with a deeper understanding of non-inertial reference frames, friction phenomena, and solid rotation around a fixed axis. In the realm of non-inertial reference frames, students explore the principles and equations necessary to analyze and solve problems involving accelerated systems. They learn to account for the effects of fictitious forces, such as centrifugal and Coriolis forces, which arise in non-inertial frames. The course also delves into the intricate nature of friction, examining its various types and the factors affecting its magnitude. Students acquire the skills to analyze the behavior of objects subject to both static and kinetic friction. Lastly, the study of solid rotation around a fixed axis enables students to comprehend the kinematics and dynamics of rotating bodies, including concepts like angular velocity, angular acceleration, and moments of inertia. Overall, the course of Mechanics 2 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, focometry and Optical Systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts

020PP2CI3 Physics Laboratory 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.

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 programing – 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 quantification. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.

Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.
This course aims to provide students with a thorough understanding of key concepts related to filtering of periodic signals and sampling. Students will have the opportunity to deepen their knowledge of linear filters, understanding their operation and exploring the effects of first and second-order filters on a periodic signal. Special attention will be given to the sampling process, with a detailed study of the Nyquist-Shannon theorem, which establishes the necessary conditions to avoid spectrum folding. Additionally, students will have the opportunity to become familiar with digital filtering
Prerequisite: Physical Signals (020SPHCI1).

020STMCI4 Statics for Mechanical Engineering 2 Cr.
Statics is an introduction to learning and applying the principles required to solve engineering problems. Concepts will be applied in this course from previous courses taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. The purpose of this course is to study methods for quantifying the forces between bodies and defining their equilibrium. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Motion and changes in shape are critical to the functionality of objects and structure. Statics is an essential prerequisite for many branches of engineering, such as civil engineering and mechanical engineering, which address the various consequences of forces.
Prerequisite: Mechanics 1 (020MC1CI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.
In this course students undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction.
The student's work revolves around concrete research, analyzing reality to identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 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.
The objective of this course is to master and apply the concepts and fundamental principles of thermodynamics. It aims to develop the ability to solve practical problems using energy, mass,

and entropy balances. Indeed, energy in all its forms is studied in various machines, such as internal combustion engines, turbojets for aerospace and naval propulsion, gas or steam turbines, thermal power plants, and refrigeration systems. Special attention is then given to heat transfer problems, which require a command of powerful tools (Laplacian, divergence) in concrete situations. The student becomes familiar with partial differential equations and learns 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 diffraction grating
Prerequisite: Physical Signals (020SPHCI1).

REGULAR PREPARATORY IN CHEMICAL AND PETROCHEMICAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

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

Objectives

The objectives of the Chemical and Petrochemical Engineering program are to equip students to:

- Pursue successful professional careers by skillfully solving emerging engineering problems.
- Contribute to the sustainable growth and development of the society.
- Sustain intellectual curiosity and further expand their knowledge and skills allowing them to assimilate the advances in the profession in a changing world.
- Assume leadership roles while respecting diversity and ethical practices.

Program Learning Outcomes (Competencies)

- 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, part of the required courses)

Fundamental Courses

Required Courses (116 Cr.)
Mathematics (48 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.), Supplementary Mathematics (2 Cr.).

Sciences (46 Cr.): Atomic Structure and Chemical Bonding (2 Cr.), General Chemistry (4 Cr.), General Chemistry Laboratory (2 Cr.), Inorganic Chemistry and Laboratory (4 Cr.), Kinetics of Chemical Reactions (2 Cr.), Mechanics 1 (6 Cr.), Mechanics 2 (4 Cr.), Organic Chemistry (4 Cr.), Organic Chemistry Laboratory (2 Cr.), Physical Signals (6 Cr.), Physics Laboratory 1 (2 Cr.), Thermodynamics 1 (4 Cr.), Thermodynamics 2 (4 Cr.).
Programming (8 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.).
Engineering Fundamentals (10 Cr.): Computer-Aided Design (4 Cr.), Geology (2 Cr.), Introduction to Engineering Projects (2 Cr.), Introduction to Fluid Mechanics (2 Cr.).
Humanities (4 Cr.): Engineering at the Service of the Community (2 Cr.), USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Chemical and Petrochemical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	***2***
020GSCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1	Discrete Mathematics	6

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 1	6
020SPHNI1	Physical Signals	6
020CMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020AA1NI2	Analysis 1	4
020ATONI2	Atomic Structure and Chemical Bonding	2
020TCGNI2	General Chemistry Laboratory	2
020ALNNI2	Linear Algebra	8
020PP1NI2	Physics Laboratory 1	2

020IF1NI2	Programming 1	4
020TH1NI2	Thermodynamics 1	4
	Open Elective	2
	Total	**28**

Semester 3

Code	Course Name	Credits
020AN2NI4	Analysis 2	6
020ALBNI3	Bilinear Algebra and Geometry	6
020MC2NI3	Mechanics 2	4
020CORNI3	Organic Chemistry	4
020IF2NI3	Programming 2	4
020TH2NI3	Thermodynamics 2	4
064VALEL1	USJ Values in Daily Life	2
	Total	**30**

Semester 4

Code	Course Name	Credits
020COANI4	Computer-Aided Design	4
020CDFNI4	Differential Calculus	6
020GELNI4	Geology	2
020CITNI4	Inorganic Chemistry and Laboratory	4
020PIINI4	Introduction to Engineering Projects	2
020IMFNI4	Introduction to Fluid Mechanics	2
020CIHNI4	Kinetics of Chemical Reactions	2
020PCONI4	Organic Chemistry Laboratory	2
020PRBNI4	Probability	4
	Open Elective	2
	Total	**30**

Course description

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 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 2 6 Cr.

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

020ATONI2 Atomic Structure and Chemical Bonding 2 Cr.

This course begins with a history of atomic sciences. It allows students to master the emission and absorption spectra concepts. Then the hydrogenoids (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).

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).

020MADNI1 Discrete Mathematics 6 Cr.
Propositional logic - Mathematical reasoning - Sets - Relations - Natural numbers, induction - Applications - Algebraic calculation - Binomial coefficient and Pascal triangle - Polynomials – Arithmetic

020GSCNI1 Engineering at the Service of the Community 2 Cr.
This course aims to explore the role of engineers in modern society, with a particular focus on innovation, renewable energies, green buildings, design, food security, recycling, and other areas relevant to our daily lives. Students will learn how engineers can leverage their technical skills, knowledge, and tools to address and solve social and environmental challenges through engineering.

020ANGNI1 General Analysis 6 Cr.
This course covers the fundamental concepts of analysis, including limits, continuity, differentiation, sequences, sets of numbers, and differential equations. Its objective is to equip students with the necessary skills to effectively calculate limits, perform differentiation and solve linear differential equations of both first and second order. In addition, this course allows the development of mathematical reasoning skills. Students 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 focuses on the comprehension of hazards and risks, as well as the identification of relevant safety guidelines. It aims to enhance students' knowledge regarding laboratory procedures, techniques, and safety protocols. Additionally, the course aims to develop students' skills in qualitative chemical analysis and titration of various mineral solutions, including acids, alkaline solutions, and precipitation reactions. Furthermore, students will learn to verify theoretical information through the determination of concentrations using electrochemical analysis methods such as spectrophotometric analysis. Emphasis will be placed on familiarizing students with the equipment used in each laboratory session and establishing a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGNI1).

020GELNI4 Geology 2 Cr.

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

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.

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.

020MC1NI1 Mechanics 1 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 2 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 1 (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 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, 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.

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 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 learn key concepts such as composite and inverse functions, the numerical sequences, the circular functions, as well as definite and indefinite integrals. By studying composite and inverse functions, students 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: area calculation.

020TH1NI2 Thermodynamics 1 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 2 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 1 (020TH1NI2).

064VALEL1 USJ Values in Daily Life 2 Cr.

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

REGULAR PREPARATORY IN CIVIL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

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

Objectives

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

- Work effectively and ethically in their professional environment at local, regional and international levels.
- Advance in their careers to become leaders in their profession, through trilingual skills, life-long learning and creativity.
- Lead in a dynamic professional environment through life-long learning and development of knowledge and skills.

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, part of the required courses)

Fundamental Courses

Required Courses (116 Cr.)
Mathematics (48 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.), Supplementary Mathematics (2 Cr.).

Sciences (40 Cr.): Fluid Kinematics (2 Cr.), General Chemistry (4 Cr.), Hydrostatics (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.), Thermodynamics 2 (4 Cr.), Wave Physics (4 Cr.).
Programming (8 Cr.): Programming I (4 Cr.), Programming II (4 Cr.).
Engineering Fundamentals (16 Cr.): Building Information Modeling (2 Cr.), Computer Assisted Drawing (4 Cr.), Introduction to Engineering Projects (2 Cr.), Geology (2 Cr.), Matlab (2 Cr.), Statics (2 Cr.), Topography (2 Cr.).
Humanities (4 Cr.): Engineering at the Service of the Community (2 Cr.), USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10/40 Cr.)

30 additional credits are earned at the Department of Civil Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	***2***
020GSCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1	Discrete Mathematics	6

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 1	6
020SPHNI1	Physical Signals	6
020CMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020AA1NI2	Analysis I	4
020STFNI2	Hydrostatics	2
020ALNNI2	Linear Algebra	8
020PP1NI2	Physics Laboratory 1	2
020IF1NI2	Programming 1	4

020TH1NI2	Thermodynamics 1	4
	Open Elective	2
	Total	**26**

Semester 3

Code	Course Name	Credits
020AN2NI4	Analysis 2	6
020ALBNI3	Bilinear Algebra and Geometry	6
020MC2NI3	Mechanics 2	4
020PP2NI3	Physics Laboratory 2	2
020IF2NI3	Programming 2	4
020TH2NI3	Thermodynamics 2	4
064VALEL1	USJ Values in Daily Life	2
020PHONI3	Wave Physics	4
	Total	**32**

Semester 4

Code	Course Name	Credits
020BIMNI4	Building Information Modeling	2
020DAINI4	Computer Assisted Drawing	4
020CDFNI4	Differential Calculus	6
020CIFNI4	Fluid Kinematics	2
020GELNI4	Geology	2
020PIINI4	Introduction to Engineering Projects	2
020MATNI4	Matlab	2
020PRBNI4	Probability	4
020STANI4	Statics	2
020TOGNI4	Topography	2
	Open Elective	2
	Total	**30**

Course description

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 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 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 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 allows civil engineering students to become familiar with the concept and principles of BIM, as well as its impact on the construction industry through the use of Revit Structure (Autodesk) software. It introduces students to the modeling of reinforced concrete or steel buildings through exercises and practical examples, guiding them toward creating a complete 3D model of a building. The course content is divided into several sections, including an introduction to Revit (graphical interface, family concepts, types, instances, construction levels and axes, views), a practical application of Revit (covering columns, foundations, walls, collaboration in Revit, slabs, beams, stairs, ramps, and developing a BIM model from a DWG drawing), as well as specific aspects such as reinforced concrete reinforcement and quantity takeoffs.

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.

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).

020MADNI1 Discrete Mathematics 6 Cr.

Propositional logic - Mathematical reasoning - Sets - Relations - Natural numbers, induction - Applications - Algebraic calculation - Binomial coefficient and Pascal triangle - Polynomials – Arithmetic

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

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

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.

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.

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.

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.

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.

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.

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) - Programming 1 (020IF1NI2).

020MC1NI1 Mechanics 1 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 2 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 1 (020MC1NI1).

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 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, 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 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 (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 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).

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 1 (020MC1NI1).

020CMTNI1 Supplemental Mathematics 2 Cr.
This course equips students with the necessary skills to solve elementary mathematical problems. They learn key concepts such as composite and inverse functions, the numerical sequences, the circular functions, as well as definite and indefinite integrals. By studying composite and inverse functions, students 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: area calculation.

020TH1NI2 Thermodynamics 1 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 2 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 1 (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 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.

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).

REGULAR PREPARATORY IN COMPUTER AND COMMUNICATIONS ENGINEERING

Main Language of Instruction:

French: ◙	English: ◙	Arabic: □

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

Objectives

The objectives of the Computer and Communications Engineering program are to graduate students able 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 together 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, part of the required courses)

Fundamental Courses

Required Courses (116 Cr.)
Mathematics (48 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.), Supplementary Mathematics (2 Cr.).

Sciences (36 Cr.): Electromagnetism (4 Cr.), General Chemistry (4 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.), Wave Optics (2 Cr.).
Programming (12 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (4 Cr.).
Engineering Fundamentals (16 Cr.): Digital Systems Design (6 Cr.), Introduction to Engineering Projects (2 Cr.), Linear Electrical Systems and Networks (6 Cr.), Matlab (2 Cr.).
Humanities (4 Cr.): Engineering at the Service of the Community (2 Cr.), USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	***2***
020GSCNI1/020ESCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1/020DAMNI1	Discrete Mathematics	6

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADNI1/020DAMNI1	Discrete Mathematics	6
020GSCNI1/020ESCNI1	Engineering at the Service of the Community	2
020ANGNI1/020GANNI1	General Analysis	6
020CHGNI1/020GCHNI1	General Chemistry	4
020MC1NI1/020MH1NI1	Mechanics 1	6
020SPHNI1/020PHSNI1	Physical Signals	6
020CMTNI1/020SMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020AA1NI2/020AY1NI2	Analysis 1	4
020ALNNI2/020LALNI2	Linear Algebra	8
020INMNI2/020MINNI2	Magnetic Induction	2
020PP1NI2/020PL1NI2	Physics Laboratory 1	2
020IF1NI2/020PR1NI2	Programming I	4
020TH1NI2/020TD1NI2	Thermodynamics I	4

	Open Elective	2
	Total	**26**

Semester 3

Code	**Course Name**	**Credits**
020AN2NI4/020AY2NI3	Analysis 2	6
020ALBNI3/020BAGNI3	Bilinear Algebra and Geometry	6
020EMENI3/020ECMNI3	Electromagnetism	4
020MC2NI3/020MH2NI3	Mechanics 2	4
020PP2NI3/020PL2NI3	Physics Laboratory 2	2
020PRBNI4/020PRONI3	Probability	4
020IF2NI3/020PR2NI3	Programming 2	4
020OPTNI3/020WOPNI3	Wave Optics	2
	Total	**32**

Semester 4

Code	**Course Name**	**Credits**
020CDFNI4/020DFCNI4	Differential Calculus	6
020TEDNI4/020DSDNI4	Digital Systems Design	6
020PIINI4/020IEPNI4	Introduction to Engineering Projects	2
020SRLNI4/020LESNI4	Linear Electrical Systems and Networks	6
020MATNI4/020MABNI4	Matlab	2
020IF3NI4/020PR3NI4	Programming 3	4
064VALEL1	USJ Values in Daily Life	2
	Open Elective	2
	Total	**30**

Course description

020AA1NI2/020AY1NI2 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 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.

020AN2NI4/020AY2NI3 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 (020AA1NI2/020AY1NI2).

020ALBNI3/020BAGNI3 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 (020ALNNI2/020LALNI2).

020CDFNI4/020DFCNI4 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 (020ANGNI1/020GANNI1).

020TEDNI4/020DSDNI4 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.

020MADNI1/020DAMNI1 Discrete Mathematics 6 Cr.
Propositional logic - Mathematical reasoning - Sets - Relations - Natural numbers, induction - Applications - Algebraic calculation - Binomial coefficient and Pascal triangle - Polynomials - Arithmetic

020EMENI3/020ECMNI3 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 (020ANGNI1/020GANNI1) - Physical Signals (020SPHNI1/020PHSNI1).

020GSCNI1/020ESCNI1 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.

020ANGNI1/020GANNI1 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.

020CHGNI1/020GCHNI1 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.

020PIINI4/020IEPNI4 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.

020ALNNI2/020LALNI2 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.

020SRLNI4/020LESNI4 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 (020SPHNI1/020PHSNI1).

020INMNI2/020MINNI2 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.

020MATNI4/020MABNI4 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 (020ANGNI1/020GANNI1) - Programming 1 (020IF1NI2/020PR1NI2).

020MC1NI1/020MH1NI1 Mechanics 1 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.

020MC2NI3/020MH2NI3 Mechanics 2 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 1 (020MC1NI1/020MH1NI1).

020SPHNI1/020PHSNI1 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.

020PP1NI2/020PL1NI2 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, 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.

020PP2NI3/020PL2NI3 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 (020PP1NI2/020PL1NI2).

020PRBNI4/020PRONI3 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 1 (020AA1NI2/020AY1NI2).

020IF1NI2/020PR1NI2 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.

020IF2NI3/020PR2NI3 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 (020IF1NI2/020PR1NI2).

020IF3NI4/020PR3NI4 Programming 3 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 1 (020IF1NI2/020PR1NI2).

020CMTNI1/020SMTNI1 Supplemental Mathematics 2 Cr.

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

020TH1NI2/020TD1NI2 Thermodynamics 1 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.

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.

020OPTNI3/020WOPNI3 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).

REGULAR PREPARATORY IN ELECTRICAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

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

Objectives

The objectives of the Electrical 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, part of the required courses)

Fundamental Courses

Required Courses (116 Cr.)
Mathematics (48 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.), Supplementary Mathematics (2 Cr.).
Sciences (36 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 (12 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (4 Cr.).
Engineering Fundamentals (16 Cr.): Digital Systems Design (6 Cr.), Introduction to Engineering Projects (2 Cr.), Linear Electrical Systems and Networks (6 Cr.), Matlab (2 Cr.).
Humanities (4 Cr.): Engineering at the Service of the Community (2 Cr.), USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	***2***
020GSCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1	Discrete Mathematics	6

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 1	6
020SPHNI1	Physical Signals	6
020CMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
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	2

	Total	26

Semester 3

Code	Course Name	Credits
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
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
020IF3NI4	Programming 3	4
064VALEL1	USJ Values in Daily Life	2
	Open Elective	2
	Total	**30**

Course description

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 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 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 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).

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) - 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 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.

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 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) - Programming 1 (020IF1NI2).

020MC1NI1 Mechanics 1 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 2 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 1 (020MC1NI1).

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 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, 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 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 (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 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).

020IF3NI4 Programming 3 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 1 (020IF1NI2).

020CMTNI1 Supplemental Mathematics 2 Cr.

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

020TH1NI2 Thermodynamics 1 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.

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.

REGULAR PREPARATORY IN INDUSTRIAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

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

Objectives

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

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

Program Learning Outcomes (Competencies)

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

Program Requirements

120 credits: Required courses (116 credits), Open elective courses (4 credits)
USJ General Education Program (10 credits, part of the required courses)

Fundamental Courses

Required Courses (116 Cr.)
Mathematics (48 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.), Supplementary Mathematics (2 Cr.).
Sciences (36 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 (8 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.).
Engineering Fundamentals (20 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.).
Humanities (4 Cr.): Engineering at the Service of the Community (2 Cr.), USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	***2***
020GSCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1	Discrete Mathematics	6

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 1	6
020SPHNI1	Physical Signals	6
020CMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020AA1NI2	Analysis I	4
020ALNNI2	Linear Algebra	8
020INMNI2	Magnetic Induction	2
020PP1NI2	Physics Laboratory 1	2
020IF1NI2	Programming 1	4
020TH1NI2	Thermodynamics 1	4

	Open Elective	2
	Total	**26**

Semester 3

Code	Course Name	Credits
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
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	2
	Total	**30**

Course description

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 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 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 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)

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.

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) - 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 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.

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 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) - Programming 1 (020IF1NI2).

020MC1NI1 Mechanics 1 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 2 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 1 (020MC1NI1).

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 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, 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 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 (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 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 learn key concepts such as composite and inverse functions, the numerical sequences, the circular functions, as well as definite and indefinite integrals. By studying composite and inverse functions, students 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: area calculation.

020TH1NI2 Thermodynamics 1 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.

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.

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, part of the required courses)

Fundamental Courses

Required Courses (116 Cr.)
Mathematics (48 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.), 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 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 (12 Cr.): Programming 1 (4 Cr.), Programming 2 (4 Cr.), Programming 3 (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 in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10/36 Cr.)

26 additional credits are earned at the Department of Electrical and Mechanical Engineering

Code	Course Name	Credits
	HUMANITIES	**8**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	***2***
020GSCNI1/020ESCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1/020DAMNI1	Discrete Mathematics	6

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADNI1/020DAMNI1	Discrete Mathematics	6
020GSCNI1/020ESCNI1	Engineering at the Service of the Community	2
020ANGNI1/020GANNI1	General Analysis	6
020CHGNI1/020GCHNI1	General Chemistry	4
020MC1NI1/020MH1NI1	Mechanics 1	6
020SPHNI1/020PHSNI1	Physical Signals	6
020CMTNI1/020SMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020AA1NI2/020AY1NI2	Analysis 1	4
020ISMNI2/020IMSNI2	Introduction to Materials Science	2
020ALNNI2/020LALNI2	Linear Algebra	8
020PP1NI2/020PL1NI2	Physics Laboratory 1	2
020IF1NI2/020PR1NI2	Programming 1	4
020TH1NI2/020TD1NI2	Thermodynamics 1	4

	Open Elective	2
	Total	**26**

Semester 3

Code	**Course Name**	**Credits**
020AN2NI4/020AY2NI3	Analysis 2	6
020ALBNI3/020BAGNI3	Bilinear Algebra and Geometry	6
020EMENI3/020ECMNI3	Electromagnetism	4
020ITCNI3/020IHTNI3	Introduction to Heat Transfer	2
020MC2NI3/020MH2NI3	Mechanics 2	4
020PP2NI3/020PL2NI3	Physics Laboratory 2	2
020PRBNI4/020PRONI3	Probability	4
020IF2NI3/020PR2NI3	Programming 2	4
	Total	**32**

Semester 4

Code	**Course Name**	**Credits**
020DAMNI4/020CAMNI4	Computer Assisted Drawing	4
020CDFNI4/020DFCNI4	Differential Calculus	6
020PIINI4/020IEPNI4	Introduction to Engineering Projects	2
020SRLNI4/020LESNI4	Linear Electrical Systems and Networks	6
020MATNI4/020MABNI4	Matlab	2
020IF3NI4/020PR3NI4	Programming 3	4
020STMNI4/020SMENI4	Statics for Mechanical Engineering	2
064VALEL1	USJ Values in Daily Life	2
	Open Elective	2
	Total	**30**

Course description

020AA1NI2/020AY1NI2 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 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.

020AN2NI4/020AY2NI3 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 (020AA1NI2/020AY1NI2).

020ALBNI3/020BAGNI3 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 (020ALNNI2/020LALNI2).

020DAMNI4/020CAMNI4 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.

020CDFNI4/020DFCNI4 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 (020ANGNI1/020GANNI1).

020MADNI1/020DAMNI1 Discrete Mathematics 6 Cr.

Propositional logic - Mathematical reasoning - Sets - Relations - Natural numbers, induction - Applications - Algebraic calculation - Binomial coefficient and Pascal triangle - Polynomials - Arithmetic

020EMENI3/020ECMNI3 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 (020ANGNI1/020GANNI1) - Physical Signals (020SPHNI1/020PHSNI1).

020GSCNI1/020ESCNI1 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.

020ANGNI1/020GANNI1 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.

020CHGNI1/020GCHNI1 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.

020PIINI4/020IEPNI4 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.

020ITCNI3/020IHTNI3 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 (020TH1NI2/020TD1NI2).

020ISMNI2/020IMSNI2 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.

020ALNNI2/020LALNI2 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.

020SRLNI4/020LESNI4 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 (020SPHNI1/020PHSNI1).

020MATNI4/020MABNI4 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 (020ANGNI1/020GANNI1) - Programming 1 (020IF1NI2/020PR1NI2).

020MC1NI1/020MH1NI1 Mechanics 1 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.

020MC2NI3/020MH2NI3 Mechanics 2 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 1 (020MC1NI1/020MH1NI1).

020SPHNI1/020PHSNI1 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.

020PP1NI2/020PL1NI2 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, 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.

020PP2NI3/020PL2NI3 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 (020PP1NI2/020PL1NI2).

020PRBNI4/020PRONI3 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 1 (020AA1NI2/020AY1NI2).

020IF1NI2/020PR1NI2 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.

020IF2NI3/020PR2NI3 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 (020IF1NI2/020PR1NI2).

020IF3NI4/020PR3NI4 Programming 3 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 1 (020IF1NI2/020PR1NI2).

020STMNI4/020SMENI4 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 1 (020MC1NI1/020MH1NI1).

020CMTNI1/020SMTNI1 Supplemental Mathematics 2 Cr.

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

020TH1NI2/020TD1NI2 Thermodynamics 1 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.

064VALEL1 USJ Values in Daily Life 2 Cr.

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

BACHELOR OF ENGINEERING IN CHEMICAL AND PETROCHEMICAL ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The Bachelor of Engineering in Chemical and Petrochemical Engineering aims to equip students to:

- Pursue successful professional careers by skillfully solving emerging engineering problems.
- Contribute to the sustainable growth and development of society.
- Sustain intellectual curiosity and further expand their knowledge and skills allowing them to assimilate the advances in the profession in a changing world.
- Assume leadership roles while respecting diversity and ethical practices.

Program Learning Outcomes (Competencies)

- 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

180 credits: Required courses (152 credits), Institution’s elective courses (26 credits), Open elective course (2 credits)
USJ General Education Program (26 credits – part of the above categories).

Fundamental courses

Required Courses (152 Cr.)

Business Law (2 Cr.)
Chemical kinetics/heterogeneous catalysis (2 Cr.)
Chemical Thermodynamics (4 Cr.)
Chemistry of Polymers (4 Cr.)
Communication Skills (2 Cr.)
Contactors: systems G-L, F-S, L-L (4 Cr.)
Dynamics and Process Control (4 Cr.)
Energy Management Applied to Processes and Utilities (2 Cr.)
Engineering Ethics (4 Cr.)
English (4 Cr.)
Fermentation Processes (2 Cr.)
Final Year Project (16 Cr.)
Fluid Mechanics (4 Cr.)
Formulation Processes (2 Cr.)
Ideal and Non-ideal Reactors (4 Cr.)
Industrial Chemistry (4 Cr.)
Internship (2 Cr.)
Internship II (2 Cr.)
Introduction to Continuous and Discontinuous Processes (4 Cr.)
Mass and Energy Balances (6 Cr.)
Mass Transfer (4 Cr.)
Mathematical Techniques in Chemical Engineering (6 Cr.)
Mechanical Agitation and Transfer (2 Cr.)
Modeling and Simulation (2 Cr.)
Numerical analysis (4 Cr.)
Petrochemical Processes (4 Cr.)
Process Design Project (6 Cr.)
Process Engineering Lab (2 Cr.)
Process Equipment Design (4 Cr.)
Production Management (2 Cr.)
Programming and Databases (4 Cr.)
Project Management (2 Cr.)
Quality Health Safety (2 Cr.)
Refining Processes (6 Cr.)
Separation Techniques (6 Cr.)
Statistics (4 Cr.)
Theoretical Chemistry (4 Cr.)
Thermal Engineering (4 Cr.)
Total Synthesis and Activation Methods (2 Cr.)

Unit Operations: Adsorption, Drying, Crystallization (4 Cr.)

Institution's Elective Courses (24 Cr.)

Six courses to choose from the list below

Biochemical Techniques and Instrumentation (4 Cr.)
Composite Materials (4 Cr.)
Cosmetic Technology (4 Cr.)
Design and Construction of Wells (4 Cr.)
Digital Technologies Applied to Chemical Engineering (4 Cr.)
Drilling Technology (4 Cr.)
Food Manufacturing and Packaging (4 Cr.)
Microbiology-Enzymatic Catalysis (4 Cr.)
Petroleum Production (4 Cr.)
Pharmaceutical Process Design (4 Cr.)
Reservoir Engineering (4 Cr.)
Solid and Hazardous Waste Management (4 Cr.)
Statistical Analysis and Design of Pharmaceutical Operations (4 Cr.)
Tribology and Lubricants (4 Cr.)
Wastewater Treatment (4 Cr.)

One restricted elective to choose either

Entrepreneurship (2 Cr.) or Work Ready Now (2 Cr.)

Open Elective Course

Arabic Culture and Language (2 Cr.)

USJ General Education Program (26/36 Cr.)

10 additional credits are earned at the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGCS4	English	4
	ARABIC	**4**
	Arabic Language and Culture	***2***
	One Arabic Culture and Language course to be selected among:	2
435LALML2	Arabic Language and Media	
435LALAL2	Arabic Language and Arts	
435LRCTL2	Arabic Language: Contemporary Novel, Cinema, and Theater	
	Other Courses Taught in Arabic	***2***
020DROCS2	Business Law	2
	HUMANITIES	**4**

	Ethics	***4***
020ETHCS1	Engineering Ethics	4
	SOCIAL SCIENCES	**6**
	Professional Integration and/or Entrepreneurship	***2***
020ENPCS4 020WORCS4	One Institution's elective course to be selected between: Entrepreneurship Work Ready Now	2
	Other Social Sciences Courses	***4***
020GEPCS4	Production Management	2
020GPRCS5	Project Management	2
	COMMUNICATION TECHNIQUES	**8**
020COMCS2	Communication Skills	2
020PDPCS4	Process Design Project	2 out of 6
020MFECS6	Final Year Project	4 out of 16

Suggested Study Plan

Semester1

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

Semester 2

Code	**Course Name**	**Credits**
	Arabic Open Elective	2
020DROCS2	Business Law	2
020COMCS2	Communication Skills	2
020MEFCS2	Fluid Mechanics	4
020RNICS2	Ideal and Non-ideal Reactors	4
020CHICS2	Industrial Chemistry	4
020PROCS2	Introduction to Continuous and Discontinuous Processes	4
020PDTCS2	Mass Transfer	4
020QHSCS2	Quality Health Safety	2
020STACS2	Statistics	4

020STMCS2	Total Synthesis and Activation Methods	2
	Total	**34**

Semester 3

Code	**Course Name**	**Credits**
020DCPCS3	Dynamics and Process Control	4
020ST1CS3	Internship (S2-S3)	2
020MOSCS3	Modeling and Simulation	2
020PRPCS3	Refining Processes	6
020TESCS3	Separation Techniques	6
020GTHCS3	Thermal Engineering	4
020OPUCS3	Unit Operations: Adsorption, Drying, Crystallization	4
	Institution’s Elective	4
	Total	**32**

Semester 4

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

Semester 5

Code	**Course Name**	**Credits**
020GEACS5	Energy Management Applied to Processes and Utilities	2
020PFOCS5	Formulation Processes	2
020BRFCS5	Fermentation Processes	2
020ST2CS5	Internship II	2
020GEPCS5	Process Engineering Lab	2
020GPRCS5	Project Management	2
	Institution’s Electives	20
	Total	**32**

Semester 6

Code	**Course Name**	**Credits**
020MFECS6	Final Year Project	16
	Total	**16**

Course Description

435LALML2 Arabic Language and Arts 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop fundamental language skills while exploring a variety of cultural themes.

Specific objectives:

- Explore the diversity of Arabic artistic expressions.
- Understand the role of art in Arab culture and identity.

435LALAL2 Arabic Language and Media 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop fundamental language skills while exploring a variety of cultural themes.

Specific objectives:

- Understand the Arab media landscape and analyze its role in contemporary society.
- Develop critical media analysis skills in Arabic.

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

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop fundamental language skills while exploring a variety of cultural themes.

Specific objectives:

- Deepen knowledge of major Arabic literary and cinematic works.
- Develop critical thinking and debate skills in Arabic.

020TBICS5 Biochemical Techniques and Instrumentation 4 Cr.

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

020DROCS2 Business Law 2 Cr.

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

020CCHCS1 Chemical Kinetics/Heterogeneous Catalysis 4 Cr.

Reactions in open and closed sequences. Basic concepts of catalysis and heterogeneous kinetics. Different stages of catalytic action (diffusion, adsorption, and surface reaction). Properties of solid catalysts and their main industrial and environmental applications.

Prerequisite: Kinetics of Chemical Reactions (020CIHNI4)

020THCCS1 Chemical Thermodynamics 4 Cr.

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

020CHPCS1 Chemistry of Polymers 4 Cr.

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

020COMCS2 Communication Skills 2 Cr.

Communication is of high importance for an engineering student. Indeed, whether in academic or professional activities, transmitting information is a powerful tool for convincing and even influencing. Communication is unavoidable, but it includes many errors and risks to be avoided. Otherwise, the reception of the information may be disturbed and misunderstood. This course offers students knowledge of essential basic rules of main ways of communication (written, verbal and non-verbal) and making them aware of the errors to be avoided.

020MACCS5 Composite Materials 4 Cr.

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

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

This course covers the design, sizing, and application of gas-liquid (G-L), liquid-liquid (L-L), and fluid-solid (F-S) contactors in industrial processes. It includes both G-L and L-L separation technologies, such as tray and packed columns, countercurrent flow systems, and the

selection criteria for various contactor devices. The course also explores fluid dynamics, characterization of solids, and hydrodynamic regimes in fixed and fluidized beds, with a focus on industrial applications and heat transfer mechanisms. Students will gain practical insights into the advantages, disadvantages, and technological considerations for each type of contactor system. Practical work.
Prerequisite: Mass Transfer (020PDTCS2)

020TCOCS5 Cosmetic Technology 4 Cr.

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

020CRPCS5 Design and Construction of Wells 4 Cr.

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

020DTECS5 Digital Technologies Applied to Chemical Engineering 4 Cr.

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

020TDFCS3 Drilling Technology 4 Cr.

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

020DCPCS3 Dynamics and Process Control 4 Cr.

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

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

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

020ANGCS4 English 4 Cr.

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

020ENPCS4 Entrepreneurship 2 Cr.

Should you become an entrepreneur? What skills do entrepreneurs need? Entrepreneurs in a market economy. Selecting a type of ownership. Developing a business plan. Identifying and addressing a market need. Financing, protecting, and insuring your business. Choosing your location and starting a business. Marketing your business. Hiring and managing personnel. Record keeping and accounting. Financial management. Using technology. Fulfilling your legal, ethical, and social obligations.

020ETHCS1 Engineering Ethics 4 Cr.

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

020BRFCS5 Fermentation Processes 2 Cr.

Methods of microbiology. Microbial growth: analysis. Microbial growth: kinetic analysis. Growth and production reactions. Microbial growth: methods for biomass measurement. Microbial cell: structure and function (schema). Kinetic analysis of fermentation. Overview of metabolism (nutrition; substrates and products). Major metabolic pathways. Microbial processes: kinetic laws, kinetics of industrial processes. Modeling of fermentation processes: physiological models, industrial fermentation.

020MEFCS2 Fluid Mechanics 4 Cr.

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

020MFECS6 Final Year Project 16 Cr.

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

020FEACS5 Food Manufacturing and Packaging 4 Cr.

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

020PFOCS5 Formulation Processes 2 Cr.

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

020RNICS2 Ideal and Non-Ideal Reactors 4 Cr.

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

020CHICS2 Industrial Chemistry 4 Cr.

Introduction to industrial engineering, through a comparative study of processes in inorganic chemistry and organic chemistry: This course allows students to analyze a process diagram and, conversely, to design a block diagram based on the description of the process. This course teaches students the design of the first flow sheet of a process based on its description, the choice of technology (reactor, separations), the positioning of recycling, purges, the production chain, the industry economy interaction etc. The course ultimately provides some elements on the safety aspects and the environmental impact of the processes.

020PROCS2 Introduction to Continuous and Discontinuous Processes 4 Cr.

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

020BMECS1 Mass and Energy Balances 6 Cr.

Unit operations and degree of freedom analysis. Material balances on unit processes. Calculations on multi-unit processes. Material balances in processes with reaction. Multiple

systems with reaction, recycling, and purging. Energy balances in the absence of reaction. Energy balances with reaction; Material and energy balances under transient conditions.
Prerequisite: Thermodynamics II (020TH2NI3)

020PDTCS2 Mass Transfer 4 Cr.
Identification of mass transfer mechanisms. Formulation of rate equations. Estimation of diffusion coefficients for binary gas and liquid phase systems. Determination of molar fluxes for steady-state diffusion of A through stagnant B and for equimolar counter-diffusion. Listing fluxes through porous solids for both types of diffusion: molecular and Knudsen. Explanation of mass transfer coefficient concept for turbulent diffusion by analogy with molecular diffusion. Calculation of interfacial mass transfer rates as a function of local mass. Definition and use of overall mass transfer coefficients. Definition and generation of minimum and actual operating curves for co-current and counter-current processes in steady state.

020TMCCS4 Mathematical Techniques in Chemical Engineering 6 Cr.
Review of fundamental properties used in optimization. Optimization problem (mathematical programming). Derivation. Notion of topology. Convexity. Convexity analysis. Eigenvalues. One-dimensional search. Definitions and general assumptions. Method of direct search for the golden ratio. Quadratic interpolation method (quasi-Newton). Examples. Conclusion. Theoretical aspects of unconstrained optimization. Problem formulation. Fundamental theorem. Conclusion. Numerical methods for unconstrained problems. Fundamental principle of descent methods. Descent direction. Step length. Termination test(s). First-order methods. Second-order Newton method. Quasi-Newton methods. Generalized reduced gradient, SQP.
Prerequisite: Dynamics and Process Control (020DCPCS3)

020AMTCS4 Mechanical Agitation and Transfer 2 Cr.
This course focuses on mechanical agitation and mass transfer principles in bioreactors, with an in-depth exploration of stirred aerated reactors. Key topics include the hydrodynamic constraints in mechanical mixing, the impact of agitation on transfer rates, and the modeling and extrapolation of fermentation processes. Students will gain a comprehensive understanding of how mechanical agitation influences bioreactor performance and the overall efficiency of fermentation.
Prerequisite: Mass Transfer (020PDTCS2)

020MCECS3 Microbiology - Enzymatic Catalysis 4 Cr.
Introduction and history. Ultrastructure and morphology. Bacterial systematics. Growth and physiology. Bacteria/host relationship. Bacterial genetics. Antibiotics/antiseptics. Introduction: nucleic acid structure, restriction enzymes. Different types of RNA. Transcription in eukaryotes and prokaryotes. Post-transcriptional modifications in eukaryotes and prokaryotes. Transcriptional regulation. Ribozymes. Genetic code and translation in eukaryotes and prokaryotes. Post-translational modifications. Replication. Sequencing. Different molecular biology tools. Introduction to biotechnology. Enzymatic processes: kinetic laws, trends in industrial enzymology, models of starch hydrolysis processes. Processes with immobilized enzymes and cells: immobilized enzyme technology, fixed cell technology.

020MOSCS3 Modeling and Simulation 2 Cr.

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

Prerequisite: Computer-Aided Design (020COANI4)

020ANNCS1 Numerical Analysis 4 Cr.

General introduction to numerical methods. Approximation and interpolation. Numerical integration. Numerical differentiation. Numerical solution of differential equations. Systems of linear equations. Nonlinear equations and systems of nonlinear equations. Methods for computing eigenvalues. Partial differential equations.

Prerequisite: Analysis II (020AN2NI4), Bilinear Algebra and Geometry (020ALBNI3)

020PPCCS4 Petrochemical Processes 4 Cr.

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

Prerequisite: Refining Processes (020PRPCS3)

020CPPCS3 Pharmaceutical Process Design 4 Cr.

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

020PRPCS5 Petroleum Production 4 Cr.

A course on theoretical and practical methods of calculations and operations of petroleum production: Production from Undersaturated, two-phase and NG Oil Reservoirs; Wellbore Flow Performance and deliverability; Forecast of well production; Artificial production; Well stimulation techniques.

Prerequisite: Drilling Technology (020TDFCS3)

020CEPCS4 Process Equipment Design 4 Cr.

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

020PDPCS4 Process Design Project 6 Cr.

The objective of the Process Design Project is to give students the opportunity to place their knowledge in a process context. Teams of 2 to 4 students work on creating or modifying a flowsheet for the manufacture of a desired chemical product.

Prerequisite: Modeling and Simulation (020MOSCS3)- Pre or Co-requisite: Process Equipment Design (020CEPCS4)

020GEPCS4 Production Management 2 Cr.

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

020GEPCS5 Process Engineering Lab 2 Cr.

The "Process Engineering Lab" course offers an exploration of four fundamental methods used in industry for the efficient separation of dissolved or suspended substances within complex mixtures. These techniques include liquid-liquid extraction, absorption, distillation and reverse

osmosis. Through this laboratory course, students will have the opportunity to gain a concrete understanding of these processes and their applications, while enhancing their problem-solving skills through practical experiments and data collection.
Prerequisite: Separation Techniques (020TESCS3)

020IBDCS1 Programming and Databases 4 Cr.

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

020GPRCS5 Project Management 2 Cr.

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

020QHSCS2 Quality, Health, Safety 2 Cr.

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

020PRPCS3 Refining Processes 6 Cr.

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

Steam cracking. Aromatic loop. Selective hydrogenations. Ethylbenzene – Styrene, PEHP. Petroleum analysis lab.
Prerequisite: Organic Chemistry (020CORNI3)

020IDRCS5 Reservoir Engineering 4 Cr.
Darcy's law and applications. Permeability concepts. Relative permeability. Capillary pressure. Wettability. Material balance equations for different types of reservoirs and drives. Aquifer behavior and water influx. Immiscible displacement. Buckley-Leverett theory. Stable displacement by gravity. Coning and cresting. Decline curve analysis. Reservoir and well deliverability.
Prerequisite: Geology (020GELNI4)

020TESCS3 Separation Techniques 6 Cr.
Physical aspects of phenomena (definition, application). Equilibria, solutions, and solubility, solvent selection. Analysis by macroscopic balances: variance, balance, operating curve, and function diagram. Countercurrent absorption of a component: cut. Scope of the problem and assumptions. Algebraic resolution. Graphical treatment. Distillation of a binary mixture. McCabe and Thiele Method - Ponchon-Savarit Method - Incidence of operating conditions. Multicomponent distillation. Problem analysis - Short Cut Method (Fensk, Underwood, Gilliland, Kirkbridge Relation). Solvent selection, characteristics, and properties of solvents. Equilibria between liquid phases. Study of simple, multiple-contact, and countercurrent contactors with and without reflux. Understanding the mechanisms of liquid-solid separation and the fundamental equations for sizing industrial equipment for this separation. Decantation: theoretical study - limiting settling velocity. Experimental study. Modeling of continuous decanters with vertical walls. Sizing of continuous decanters with vertical walls. Filtration: definitions and ancillary techniques. Theory of filtration on support. Application examples. Membrane filtration: membrane separation techniques. Osmotic pressure. Polarization phenomenon. Mechanisms of fouling. Electrodialysis compartments. Centrifugation: centrifugal effect and centrifugal pressure of filtration. Centrifugal squeezing and flow rates.
Prerequisite: Chemical Thermodynamics (020THCCS1)

020GDSCS5 Solid and Hazardous Waste Management 4 Cr.
This waste management course offers students a thorough understanding of core principles, waste generation methods, environmental and health impacts, and a range of management options including sanitary landfills, material recovery, energy recovery, waste minimization, thermal treatment, chemical/physical/biological treatment, site remediation, and waste sorting/recycling facilities. By examining current and future trends, students will be equipped to develop and implement effective strategies for reducing environmental effects, advancing circular economy practices, and contributing to global sustainability.

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

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

020STACS2 Statistics 4 Cr.

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

020ST1CS3 Summer Internship I 2 Cr.

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

020ST2CS5 Summer Internship II 2 Cr.

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

020CHTCS1 Theoretical Chemistry 4 Cr.

Introduction to quantum phenomena, postulates of quantum mechanics: angular momentum, hydrogen atom. Major approximation methods: variational principle, perturbation theory. Multi-electron atom. Approximation of atomic orbitals. Approximation of molecular orbitals and quantum chemistry methods: Hartree-Fock, Hückel method. Application to diatomic and polyatomic molecules. Role of spatial symmetry. Introduction to reactivity. Approximation of frontier orbitals.

Prerequisite: Atomic Structure and Chemical Bonding (020ATONI2)

020GTHCS3 Thermal Engineering 4 Cr.
Study of convection (natural convection: empirical relationships, forced convection in pipes, laminar regime - theoretical and empirical relationships, turbulent regime - empirical relationships, Extension to non-cylindrical pipes and film flows, forced convection around solid obstacles, case of cylinder and sphere, case of tube bundles, case of the shell of a multitubular exchanger). Heat exchanger theory (co-current, counter-current, and multi-pass approaches, definition and expression of overall heat transfer coefficient, DTML method, Efficiency method, practical sizing method: this part is essentially treated using the example of multitubular exchangers). Other heat transfer technologies (plate and spiral exchangers, transfer in agitated tanks). Phase change heat transfer (condensation of pure vapor, condensation of a vapor mixture). Practical Work.
Prerequisite: Thermodynamics II (020TH2NI3)

020STMCS2 Total Synthesis and Activation Methods 2 Cr.
This course covers the principles and methods of total synthesis, with a focus on industrial alternatives, synthesis planning, and retro synthesis techniques. Key topics include solutions to chemoselectivity issues, protection of functional groups, enantiomer splitting techniques, and asymmetric induction. Students will explore prediction of stereochemistry from diastereoselective reactions, asymmetric synthesis strategies, and enzymatic engineering for industrial applications. The course also touches on green chemistry principles, sustainable practices in synthetic processes, bioprocesses, and green alternatives to conventional solvents. Additionally, it introduces the principles and applications of electrosynthesis, sonochemistry, and microwave activation, with a focus on their advantages, limitations, and industrial-scale implications.
Prerequisite: Organic Chemistry (020CORNI3)

020MLTCS5 Tribology and Lubricants 4 Cr.
This course explores the study of tribology and lubricants, covering fundamental principles related to friction, wear, and lubrication. Additionally, the course explores topics such as lubricating base oils and their importance in technical applications.
Prerequisite: Refining Processes (020PRPCS3) - Fluid Mechanics (020MEFCS2)

020OPUCS3 Unit Operations: Adsorption, Drying, Crystallization 4 Cr.
Designing adsorption columns. Mass transfer zone and breakthrough curve in a fixed-bed column. Empirical methods: unused bed length. Scaling approach. Mathematical models (Thomas model, Bohart-Adams model (bed depth service time, BDST), Yoon Nelson model). Drying. Dryer efficiency. Mass transfer in drying. Psychrometry. Equilibrium relative humidity. Drying rates. Calculation of drying times. Material and energy balance on a continuous dryer. Different types of dryers. Crystallization. Fundamentals of crystal growth. Measurement of growth rate. Crystal yield. Crystallization technologies. Equipment for solution crystallization.

Crystallization in the molten state. Modeling and design of crystallizers. Lab work: 1-Drying 2-Crystallization
Prerequisite: Chemical Thermodynamics (020THCCS1)

020TEUCS5 Wastewater Treatment 4 Cr.
Classification of wastewater from different perspectives. Assessment of wastewater pollution. Equipment of wastewater treatment plants. Technological lines for wastewater treatment and sludge disposal. Mechanical, chemical, and biological stages of wastewater treatment. Pretreatment and primary stage of wastewater treatment - mechanical separators, sedimentation and flotation, settler. Secondary stage of wastewater treatment - activation and secondary settler, basic parameters of activation, types of aerobic bioreactors, nitrification and denitrification, phosphorus removal. Tertiary stage of wastewater treatment - post-treatment of wastewater. Anaerobic processes - types of anaerobic bioreactors. Treatment of sewage sludge. Industrial wastewater treatment. Physico-chemical and chemical treatment processes. Modeling, design, and optimization of activated sludge process. An introduction to automatic control of wastewater treatment plants.

020WORCS4 Work Ready Now 2 Cr.
This course is designed to provide students with general skills, communication skills, and workplace learning experiences to prepare them for success in the workplace. It is designed to facilitate participatory and practical teaching and learning. Students will be actively engaged in the learning process and will have the opportunity to practice and enhance new skills and gain the self-confidence needed to obtain and maintain employment related to their career goals. Workplace learning activities are integrated into the course and will require students to visit real workplaces in the profession outside of class hours. Students will be guided to use free online digital tools to demonstrate their learning. Throughout the course, students will create a career portfolio that will assist them in their Work Ready Now experimental journey from student to employee.

BACHELOR OF ENGINEERING IN CIVIL ENGINEERING

Main Language of Instruction:

French : ◙	English : □	Arabic : □

Campus Where the Program Is Offered: CST

Objectives

The Civil Engineering Program aims to train engineers with high scientific and technical expertise in design and construction, equipped to work in civil engineering, building and engineering structures, public works and transportation, water, and environmental sectors. Graduates will have a global and multidisciplinary approach to projects and their management

This program enables graduates to:

- Work effectively and ethically in their professional environment at local, regional, and international levels.
- Advance in their careers to become leaders in their profession, through trilingual skills, continuous learning, and creativity.
- Lead in a dynamic professional environment through continuous education and the development of knowledge and skills.

Program Learning Outcomes (Competencies)

The student outcomes are aligned with the ABET requirements:

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

Program Requirements

180 Credits: Required courses (132 credits), Program option courses (42 credits), Institution's elective courses (2 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits – part of the above categories).

Required Courses (132 Cr.)

General Courses (16 Cr.)

Ethics and Engineering (4 Cr). General and Analytical Accounting (2 Cr). General Economics (2 Cr.). Environment and Sustainable Development (2 Cr.). Communication and Work Ready Now (2 Cr.). English (4 Cr.).

Core Engineering Courses (84 Cr.)

Building Rules and Regulations (2 Cr.). Continuum Mechanics (4 Cr.). Construction Materials (6 Cr.). Numerical Analysis (4 Cr.). Strength of Materials (6 Cr.). Fluid Mechanics (6 Cr.). Soil and Rock Mechanics (6 Cr.). Basis of Structural Design - Structural Load Calculations (4 Cr.). General Construction Procedure (4 Cr.). Statistics (4 Cr.). Hydraulics (6 Cr.). Foundation Engineering (6 Cr.). Reinforced Concrete (6 Cr.). Steel and Mixed Structures (6 Cr.). Structures (6 Cr.). Buildings and Frames (4 Cr.). Finite Elements (4 Cr.)

Internships (6 Cr.)

During this program, each student is required to undertake three internships:

One-week training in surveying at the beginning of the third year (2 Cr.), a minimum of 4-week-labor internship at the end of the third year (0 Cr.), a minimum of 8-week-scientific and technical internship at the end of the fourth year (4 Cr.).

Projects (26 Cr.)

During this program, each student is required to complete 3 projects:

- An Architectural Project: This project brings together students from different options within the Department of Civil and Environmental Engineering. Teams of 2 students are formed. The goal is to prepare a building's permit and execution drawings according to appropriate standards and building legislation. (4 Cr.)
- A Multidisciplinary Project: This project brings together students from different options of the Civil Engineering Program. Teams of 2 to 3 students are formed. The goal is to prepare construction drawings of a building according to appropriate standards including structural drawings, foundations design, and more. (6 Cr.)

- A Final Year Project: This project lasts for 4 months. Teams of 3 to 5 students are formed. The goal is to engage students in a real-world design office where they must establish a concept, analyze, and design a civil engineering structure while adhering to specific requirements and constraints. (16 Cr.)

Program Option Courses (42 Cr.)

Option Buildings and Engineering Management

American Code of Reinforced Concrete (4 Cr.). Building Acoustics (2 Cr.). Building Fire Safety (2 Cr.). Building Lighting and Sanitary (4 Cr.). Building Thermal Design (2 Cr.). Design of Buildings Structures (4 Cr.). Buildings Finance Management (2 Cr.). Market Globalization (2 Cr.). Planning and Management of Large-Scale Projects (4 Cr.). Prestressed Concrete in Buildings (2 Cr.). Quality Management in Buildings (2 Cr.). Rehabilitation and Maintenance of Concrete Structures (4 Cr.). Special Topics in Concrete (2 Cr.). Structural Dynamics and Earthquake Engineering (4 Cr.). Structural Software (2 Cr.)

Option Water and Environment

Applied Hydraulics Software (2 Cr.). Dams (4 Cr.). Data Measurement and Acquisition (2 Cr.). Environmental Impact Assessment (2 Cr.). Environmental Law (2 Cr.). Geographic Information Systems (2 Cr.). Groundwater Hydraulics (2 Cr.). Hydrology, (4 Cr.). Irrigation (2 Cr.). Karst Hydrogeology (2 Cr.). Maritime Structures (2 Cr.). Solid Waste Management (2 Cr.). Statistical Hydrology (4 Cr.). Urban Drainage (2 Cr.). Water Distribution Networks (4 Cr.). Water and Wastewater Treatment (4 Cr.)

Option Public Works and Transportation

American Code of Reinforced Concrete (4 Cr.). Dams (4 Cr.). Pavement Engineering (4 Cr.). Plates and Shells (4 Cr.). Prestressed Concrete (4 Cr.). Rehabilitation and Design of Concrete Bridges (4 Cr.). Structures Plastic Behavior (2 Cr.). Shear Strength and Geohazards (4 Cr.). Special Topics in Concrete (2 Cr.). Structural Dynamics and Earthquake Engineering (4 Cr.). Structural Software (2 Cr.). Traffic Engineering (2 Cr.). Transport and Airport Engineering (2 Cr.)

Institution's Elective Civil Engineering Courses (2 Cr.)

One course to be selected from the following list:

Urban and Landscape Planning (2 Cr.). Protection and Aesthetics of Buildings (2 Cr.). Industrial Construction (2 Cr.). Engineering Geology (2 Cr.). Artificial Intelligence in Civil Engineering (2 Cr.)

Open Elective Courses (4 Cr.)

General Education courses that can be pursued in any USJ institution, with at least two credits of Arabic Language or Arabic Culture.

USJ General Education Program (26/36 Cr.)

10 additional credits are earned at the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGGS4	English	4
	ARABIC	**4**
	Arabic Language and Culture	***2***
	One Arabic Culture and Language course to be selected among:	2
435LALML2	Arabic Language and Media	
435LALAL2	Arabic Language and Arts	
435LRCTL2	Arabic Language: Contemporary Novel, Cinema, and Theater	
	Other Courses Taught in Arabic	***2***
020LEBGS1	Building Rules and Regulations	2
	HUMANITIES	**4**
	Ethics	***4***
020ETHGS1	Ethics and Engineering	4
	SOCIAL SCIENCES	**6**
	Professional Integration and/or Entrepreneurship	***2***
020LEBGS1	Building Rules and Regulations	2
	Other Social Sciences Courses	***4***
020ECGGS1	General Economics	2
020CGAGS1	General and Analytical Accounting	2
	COMMUNICATION TECHNIQUES	**8**
020WRNGS1	Communication and Work Ready Now	2
020PBAGS4	Multidisciplinary Project	2 out of 6
020PBAGS6 020PEAGS6 020PTPGS6	Final Year Project	4 out of 16

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020PARGS1	Architectural Project	4
020LEBGS1	Building Rules and Regulations	2

020MMDGS 1	Continuum Mechanics	4
020ETHGS1	Ethics and Engineering	4
020MAIGS1	Construction Materials	6
020ENVGS1	Environment and Sustainable Development	2
020CGAGS1	General and Analytical Accounting	2
020ECGGS1	General Economics	2
020ANNGS1	Numerical Analysis	4
020STOGS1	Surveying	2
020WRNGS 1	Communication and Work Ready Now	2
	Total	**34**

Semester 2

Code	**Course Name**	**Credits**
020MEFGS2	Fluid Mechanics	6.
020PGCGS2	General Construction Procedures	4
020MESGS2	Soil and Rock Mechanics	6
020STAGS2	Statistics	4
020RDMGS 2	Strength of Materials	6
020ACTGS2	Basis of Structural Design - Structural Load Calculations	4
	Arabic Open Elective	2
	Total	**32**

Semester 3

Code	**Course Name**	**Credits**
020FOSGS3	Foundation Engineering	6
020HYDGS3	Hydraulics	6
020BEAGS3	Reinforced Concrete	6
020CMMGS 3	Steel Structures	6
	Program Option Courses (8 Cr)	
 020ACIGS3 020QUAGS3 020GEFGS3	**Option: Buildings and Engineering Management** American Code of Reinforced Concrete Quality Management in Buildings Buildings Finance Management	 4 2 2
 020DEAGS3 020GISGS3 020DREGS3	**Option: Water and Environment** Water Distribution Networks Geographic Information Systems Environmental Law	 4 2 2
020ACIGS3 020TRAGS3	**Option: Public Works and Transportation** American Code of Reinforced Concrete	4 2

020AERGS3	Traffic Engineering Transport and Airport Engineering	2
	Total	**32**

Semester 4

Code	**Course Name**	**Credits**
020ANGGS4	English	4
020OSBGS4	Buildings and Frames	4
020EFIGS4	Finite Elements	4
020PBAGS4	Multidisciplinary Project: Building Design, Foundations and Structures	6
020STRGS4	Structures	6
	Program Option Courses (6 Cr.)	
 020RESGS4 020CTHGS4	**Option: Buildings and Engineering Management** Building Lighting and Sanitary Building Thermal Design	 4 2
 020IMPGS4 020IRRGS4 020ASSGS4	**Option: Water and Environment** Environmental Impact Assessment Irrigation Urban Drainage	 2 2 2
 020ROUGS4 020PLSGS4	**Option: Public Works and Transportation** Road and Pavement Engineering Structures Plastic Behavior	 4 2
	Restricted Civil Engineering Elective	2
	Open Elective	2
	Total	**34**

Semester 5

Code	**Course Name**	**Credits**
020STEGS5	Summer Internship	4
	Program Option Courses (28 Cr.)	
020ACBGS5 020SEIGS5 020COSGS5 020MOGGS5 020PLGGS5 020BPRGS5 020REMGS5 020OSPGS5 020DYSGS5 020LOCGS5	**Option: Buildings and Engineering Management** Building Acoustics Building Fire Safety Design of Buildings Structures Market Globalization Planning and Management of Large-Scale Projects Prestressed Concrete in Buildings Rehabilitation and Maintenance of Concrete Structures Special Topics in Concrete Structural Dynamics and Earthquake Engineering Structural Software	 2 2 4 2 4 2 4 2 4 2
	Option: Water and Environment	

020LOGGS5	Applied Hydraulics Software	2
020BAGGS5	Dams	4
020MEAGS5	Data Measurement and Acquisition	2
020HSOGS5	Groundwater Hydraulics	2
020HYDGS5	Hydrology,	4
020HKAGS5	Karst Hydrogeology	2
020OUMGS5	Maritime Structures	2
020DESGS5	Solid Waste Management	2
020HYSGS5	Statistical Hydrology	4
020GEPGS5	Water and Wastewater Treatment	4
	Option: Public Works and Transportation	
020BAGGS5	Dams	4
020PLCGS5	Plates and Shells	4
020BEPGS5	Prestressed Concrete	4
020COCGS5	Rehabilitation and Design of Concrete Bridges	4
020RCGGS5	Shear strength and Geohazards	4
020OSPGS5	Special Topics in Concrete	2
020DYSGS5	Structural Dynamics and Earthquake Engineering	4
020LOCGS5	Structural Software	2
	Total	**32**

Semester 6

Code	**Course Name**	**Credits**
020PBAGS6	**Option: Buildings and Engineering Management** Final Year Project FYP	16
020PEAGS6	**Option: Water and Environment** Final Year Project FYP	16
020PTPGS6	**Option: Public Works and Transportation** Final Year Project FYP	16
	Total	**16**

Course description

020ACIGS3 American Code of Reinforced Concrete (ACI) 4 Cr.

This course focuses on the design of reinforced concrete structures according to the American Concrete Institute (ACI) code. Topics covered include: Introduction to ACI - Comparison between European and American codes - Pure tension - Pure compression - Pure bending - Bending plus compression or tension - Shear and torsion.

Prerequisites: None

020LOGGS5 Applied Hydraulics Software 2 Cr.
This course introduces students to the hydraulic aspects and techniques of designing a hydraulic structure. Students will apply theoretical, topographical, hydrological and hydraulic principles in the dimensioning of specific hydraulic structures. Topics covered include: Basic hydraulic principles - Basic hydrology - Culvert hydraulics – Surface water modeling and flood routing using HEC-RAS.
Prerequisites: None

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.

020PARGS1 Architectural Project 4 Cr.
This course explains how to conceptualize, design and interpret an architectural project. Topics covered include: Initiation to architectural language - Design of a plan, organization chart, orientation - Proportion of the various elements in architecture - Fixed and mobile furniture – Staircase study – Project launching - Section plan details – Façades
Prerequisites: Computer Assisted Drawing (020DAINI4)

020IAGGS4 Artificial Intelligence in Civil Engineering 2 Cr.
This course introduces students to Machine Learning and Artificial Intelligence, with a focus on deep learning techniques. Topics covered include: Decision Trees - Multilayer Dense Deep Neural Networks - Convolutional Networks - Transformers - Automatic Natural Language Processing - AI Threats - Pytorch.
Prerequisites: None

020ASTGS4 Astronomy 2 Cr.

This course provides students with basic astronomical knowledge to better understand the importance of current and future space discoveries. Topics covered include: Celestial sphere, diurnal movement, planets, ecliptic plane - Tools of modern astronomy - Solar system - The sun - The stars - The interstellar medium - Exo planets - The ultimate states - The galaxy of the Milky Way - Galaxies – Cosmology

Prerequisites: None

020ACBGS5 Building Acoustics 2 Cr.

This course covers sound transmission problems in buildings to enhance quality of life by meeting acoustic comfort standards. Current European regulations are applied to assess and define the acoustic performance of buildings based on their purpose and environmental exposure. Topics covered include: General acoustic concepts - Receiver - Acoustic requirements - Acoustic room correction - Airborne sound insulation - Impact sound insulation - Equipment noise isolation - Acoustic studies.

Prerequisites: None

020OSBGS4 Buildings and Frames 4 Cr.

This course examines the design and dimensioning of the elements of a reinforced concrete building. Topics covered include: Action on the structures (Basic data allowing the study or the verification of a building - Calculation of loads) - Foundations (Generalities - Shallow and deep foundations) - Floors (Methods of computation - Different types of floors - Calculation of reinforced concrete beams - floor slab) - Stairs (Staircase cast in place - Prefabricated staircases - Various types of cast in place stairs).

Prerequisites: Reinforced Concrete (020BEAGS3)

020GEFGS3 Buildings Finance Management 2 Cr.

This course shows precisely what financial management is, how financial decisions can enable the company to achieve shareholder wealth and how they affect the value of the company. It focuses both on decisions related to the future management of the company and on the acquisition of new assets or new capital. It is about improving the profitability of the company while controlling its risk. Topics covered include: Financial Diagnosis (Prerequisite for any good financial management decision). Introduction to accounting. Financial Approach - The Different Values of the Company - Working Capital and Working Capital Requirements - Ratio Analysis - Cash Flow Analysis - Cash Flow and Budget. Investment Decision. The criteria of choice (certain future).

Prerequisites: General Economics (020ECGGS1) and General and Analytical Accounting (020CGAGS1)

020SEIGS5 Building Fire Safety 2 Cr.

This course covers fire safety in buildings of different types and occupational sizes. Topics covered include: Fire system installation in buildings - Accessibility of buildings by the emergency service (fire trucks) - Insulation from neighboring buildings and third buildings - Interior design of buildings - Fire resistance of structures - Clearances (traffic, door blocks, stairs, etc.) - Interior fittings - Fire characteristics of materials - Natural or mechanical smoke extraction - Emergency means (Detection, Alarm, etc.).

Prerequisites: None

020RESGS4 Building Lighting and Sanitary 4 Cr.

This course provides students with a theoretical and practical overview of the different systems and sanitary facilities. Topics covered include: Project Execution - City water supply - Distribution of cold and hot water in buildings - Water pipes installation - Valves - Wastewater or sewage evacuation - Lighting - Electrical installation.

Prerequisites: None

020LEBGS1 Building Rules and Regulations 2 Cr.

This course aims to teach the students how to develop a building construction project in accordance with building law regulations. Topics covered include: Introduction - The conditions of the inclined land and fences - The conditions of the building permit and conditions of license - Conditions of the housing permit - The roads of the property and the conditions of purchase of these public goods, the envelope of the buildings on the roads identification properties and classification concepts - The safety and public health and architectural aspects - Building rules of high height> 50m - height of buildings and number of floors of independent buildings - Portions of buildings not included in the surface and total operating coefficients: balconies, basements, floors - Parking and number of compulsory cars and alternatives. Incentive of additional and public car parks - Free height under ceiling - Expropriation Act, Act 324-Act.

Prerequisites: None

020CTHGS4 Building Thermal Design 2 Cr.

This course covers all the necessary elements to achieve thermal building design while ensuring the maximum comfort to the user. Topics covered include: Concepts of thermal comfort in the building - Energy in the building in Lebanon - Diagram of the humid air - Thermal balance winter - Envelope of the building and thermal insulation in Lebanon - Heating by forced air - Central heating with hot water - Filtering of the air - Solar hot water production - Heat pump - Summer heat balance - Cold batteries - Air conditioning modes - Ventilation and ducting networks - Bioclimatic houses - Building automation.

Prerequisites: Environment and Sustainable Development (020ENVGS1)

020DAFGS4 Business Law 2 Cr.

This course introduces future engineers to the legal world of business with presentations on budgets.

Prerequisites: None

020ECHGS4 Chess 2 Cr.

Learn Chess - Games - Moves - Strategies - Openings.

Prerequisites: None

020CHCGS4 Climate Change 2 Cr.

This course covers the climatic changes taking place and their influence on the Earth's environment.

Prerequisites: None

020WRNGS1 Communication and Work Ready Now 2 Cr.

This course provides students with the foundational "soft skills", communication skills, and work-based learning experiences to prepare them for success in the workplace. It is designed to facilitate participatory, hands-on teaching and learning. Students will be actively engaged in the learning process and provided opportunities to practice and enhance new skills and gain the self-confidence necessary to secure and maintain work related to their professional goals. Work-based learning activities are woven into the course and will require students to go to real workplaces in the community outside of class time. Students will be guided to use free online digital tools to demonstrate their learning. Throughout the course, students will create a career portfolio that will help them on their experiential Work Ready Now journey from student to employee.

Prerequisites: None

020MACGS1 Construction Materials 6 Cr.

This course introduces themes that provide a general view of the different categories of engineering materials, their behavior, and teaches students the properties and fields of use of materials in civil engineering. Topics covered include: Chemical bonds between atoms and molecules and periodic table - Elements of crystallography and defects in crystals - Diagrams of equilibrium and transfer and movement of atoms (diffusion of atoms, Fick's law, etc.) - Mechanical properties and modifications of mechanical properties (softening, hardening, refining, etc.) - Degradation of materials and anti-degradation procedures - Composite materials (wood is one of them) - Ceramics (this theme also includes concrete and glass) - Plastics and polymers. Particular attention will be given to Construction materials: Stony materials - Bonding materials - Artificial cements - Mortars - Concrete - Masonry - Metals - Glass – Wood

Prerequisites: General Chemistry (020CHGNI1 or 020CHGCI1)

020MMDGS1 Continuum Mechanics 4 Cr.

This course equips students with the basic tools to describe and model solid and fluid material environments. It provides the essential background needed for specialized courses such as mechanics of materials, fluid mechanics, reinforced concrete, soil and rock mechanics and rheology of materials. Topics covered include: General information on the mechanics of deformable media - Kinematics of deformable media - Dynamics of deformable media - Thermodynamics of deformable media - Calculation methods in linear and isotropic elasticity - Variation principles in solid mechanics

Prerequisites: Statics (020STANI4 or 020STACI4)

020CATGS4 Creative Art Therapy 2 Cr.

This course enables students to become creative in their analysis of specific situations.

Prerequisites: None

020BAGGS5 Dams 4 Cr.

This course provides an analysis of the elements to be considered for the selection and sizing of different types of dams and their appurtenant structures, and compares different solutions technically, economically and environmentally. Topics covered include: Criteria for site selection – Impact of water pressure on the foundations and structures – Safety and imperviousness of dam foundations and body – Design and stability of embankment – Appurtenant structures – Concrete rigid dams.

Prerequisites: None

020MEAGS5 Data Measurement and Acquisition 2 Cr.

This course aims to provide an understanding of the operation and use of water-related measurement devices and their associated sensors and electronics. It covers the analysis of the measurement ranges and conditions of use, as well as the supports necessary for data collection. The course also addresses the estimation of measurement precision, data processing, and transformation to present results in units relevant to the measured quantities. Students will learn to design a system and measurement protocol, define criteria for selecting measuring equipment, and explore apparatus typically used for pressurized flows. Topics covered include: Apparatus – Flow velocity measurements on a laboratory and industrial scales - Drinking water and hot water meters - Equipment for modern network management - Sensor, remote transmission and remote control concepts - Surface hydrological measurements - Climatic stations, evaporation - Limnimetry - Flow measurement - Hydrometric station calibration - Data acquisition and processing - Generalities of measurements - Level and displacement measurements - Distance measurements - Force or constraints - Temperature measurements - Pressure measurements - Fluid velocity measurements - Fluid flow measurements - Flowmeter with gyrometer - Definition of the dimension of a meter - Hydraulic and metering properties of a meter - Permissible flow rates.

Prerequisites: None

020COSGS5 Design of Buildings Structures 4 Cr.

This course focuses on the design of structures, an essential phase prior to any calculation. It aims to teach students the techniques of design and analysis of real structures. Topics covered include: Retaining walls - Bearing Walls (Bearings according to DTU-231-1 - Bearings according to Eurocode EC2) - Short consoles (Study of a short console following the BAEL - Study of a short console according to the Eurocode EC2) - Partition beams (Study of partitioned or bended-wall beams, according to the BAEL - Study of a beam according to Eurocode EC2) - Bracing (Introduction - Distribution of forces between the various splits - Design of the braces - Resent with irregularities - Example: mini bracing project) - Reservoirs in the buildings (General - Rectangular tank - Cylindrical tank) - Fire behavior of concrete structures (Area of application - Characteristics of materials as a function of temperature - Distribution of temperature in the concrete - Solicitations and principle of the justifications - Construction rules by categories of works - General method) - Principle of the domes, behavior of slabs of any form (Cupolas - Slabs of some form).

Prerequisites: Buildings and Frames (020OSBGS4)

020EJSGS4 Empowerment Skills for Job Seekers 2 Cr.

This course enhances the skills of job seekers by teaching them how to make a good presentation and write a professional report.

Prerequisites: None

020CDAGS4 Engineering Contracts and Laws of Arbitration 2 Cr.

Topics covered include: The Principles of Contracts - The Law of Arbitration.

Prerequisites: None

020GEIGS4 Engineering Geology 2 Cr.

This course covers an applied geology discipline involving the collection, analysis, and interpretation of geological data necessary for the safe development of civil works. Engineering geology also includes the assessment and mitigation of geologic hazards such earthquakes, landslides, flooding; the assessment of timber harvesting impacts; and groundwater remediation and resource.

Prerequisites: None

020ANGGS4 English 4 Cr.

This course is designed to develop critical thinking, reading, oral and written expression. It focuses on synthesizing sources to produce a research paper and defending it before an audience. Emphasis is placed on analytical reading of different types of texts required in disciplines as well as on synthesizing from various sources to produce a written text and present it orally.

Prerequisites: None

020EFEGS4 Entrepreneurship for Engineers 2 Cr.
This course explains the entrepreneurship field for engineers.
Prerequisites: None

020ENVGS1 Environment and Sustainable Development 2 Cr.
This course provides a comprehensive overview of environment and sustainable development, enabling students to assess and analyze major environmental and development challenges facing humanity, and to suggest practical and concrete issues. Topics covered include: State of the Environment - Demography - Mineral Resources - Energy Resources - Water - Solid Waste Treatment - Air Pollution - The Greenhouse Effects - The Ozone Layer.
Prerequisites: None

020IMPGS4 Environmental Impact Assessment 2 Cr.
This course introduces environmental impact assessment (EIA) of projects as a main tool for applying the principle of prevention in the protection of the environment. Topics covered include: General introduction; Overview of the EIA process - Policy, legal and administrative framework; Introduction to course project -
Prerequisites: None

020DREGS3 Environmental Law 2 Cr.
This course familiarizes students with the main environmental, ecological and water scarcity problems as well as the main regulations and laws established to address them. Topics covered include: General - Rights to water usage and consumption: origins, administration and management - Right to water in a Lebanese context - Lebanese waters and Middle Eastern negotiations - Environmental law in Lebanon
Prerequisites: None

020ETHGS1 Ethics and Engineering 4 Cr.
This course aims to teach students the principles of engineering ethics and the relationship between engineers, as well as their relationship with the order of engineers. Topics covered include: Ethics - Morals, deontology – Law - Human rights – Conscience – Freedom - Ethics and spirituality - Ethics and religions - Some current issues in the field of ethics of the person in society: bioethics in the 21st century - Some issues in the field of ethics of society at the service of the person: social, political, economic, entrepreneurial ethics - Relations between engineers - Relations with the order of engineers - Relations in the profession and with administration.
Prerequisites: None

020OREGS4 Event Organization 2 Cr.
This course aims to prepare students in a practical way to face the challenges involved in organizing public events of all kinds. Topics covered include: Define the concept of event -

Define the different types of events - Main questions to discuss - The starting point for any event is its purpose - The nature and form of the event - Decide the schedule (date and time) - The choice of place - The organizers. Planning and logistics. The budget - The site or place of the event - The resources - Decoration - Timing - Program - Animation - Restoration - Preparation of all printed material - Reception and reception – Advertising.
Prerequisites: None

020PBAGS6 Final Year Project 16 Cr.
This course enables students to apply their previously acquired knowledge for the study of a real civil engineering project, providing a complete study of a civil engineering work.
Prerequisites: None

020PEAGS6 Final Year Project 16 Cr.
This course enables students to apply their previously acquired knowledge for the study of a real civil engineering project, providing a complete study of a civil engineering work.
Prerequisites: None

020PTPGS6 Final Year Project 16 Cr.
This course enables students to apply their previously acquired knowledge for the study of a real civil engineering project, providing a complete study of a civil engineering work.
Prerequisites: None

020EFIGS4 Finite Elements 4 Cr.
This course aims to practice finite element methods through concrete examples of heat transfer, material strength, and elasticity theory. It provides the necessary elements for students to develop their technical skills and interact effectively with various software. Topics covered include: General information on the finite element method (FEM) - Strong formulation in structural mechanics and heat transfer - Integral or variational formulation - Methods of discretization of the integral form - Discretization by finite elements - Rod element in tension or compression – Bernouilli beam element - Bar elements in thermal transfer - Isoparametric formulation and numerical integration - Two-dimensional finite elements in plane elasticity and thermal transfer - Reference elements and isoparametric formulation - Numerical integration in two dimensions.
Prerequisites: Numerical Analysis (020ANNGS1).

020MEFGS2 Fluid Mechanics 6 Cr.
This course introduces students to the basic principles of fluid statics and dynamics. Topics covered include: Fluid statics – Continuity equation – Momentum equation – Energy equation – Differential formulation of the governing equations - Potential flow theory - Dimensional analysis and similitude – Viscous fluid flow – Introduction to turbulent flow.

Prerequisites: Fluid Kinematics (020CIFNI4) or Introduction to Fluid Mechanics (020IMFCI4) and Calculus 2 (020AN2NI4 or 020AN2CI3)

020FOSGS3 Foundation Engineering 6 Cr.
This course introduces students to the calculation methods and rules of the art in the field of design and construction of foundations and retaining structures. Topics covered include: Identify the mechanical and hydraulic properties of soils. Understand the principles of geotechnical investigation as well as the main field tests. Dimension conventional superficial foundations. Understand the principles of active and passive pressures, and apply them to the calculation of retaining walls and different types of walls. Excavations and Groundwater Control. Deep Foundations. Design the piles. Geotechnical Design.
Prerequisites: Soil and Rock Mechanics (020MESGS2)

020EREGS2 From Engineering to real Estate Development 2 Cr.
Topics covered include: The Real Estate field. The relation between engineering and real estate.
Prerequisites: None

020FQSRS4 Fundamental Questions about Science and Religion 2 Cr.
The course offers overviews of major scientific and mathematical theories: Chaos Theory, Quantum Mechanics, Heisenberg's Uncertainty Principle, String Theory, General Relativity, Cosmology, Black Holes, Gödel theorem, Information theory, and set theory. In a second section, it proposes a dialogue on fundamental questions: Miracles and science; Evolution; Religious pluralism; Ethics, science, and theology; what can and cannot be said about God based on science and religions, Mathematical, metaphysical and divine infinity. Other topics that will be discussed interjectionally: God's goodness, omniscience, and omnipotence versus evil and natural disasters; Beauty, scientific truth, and God; The existence of God.
Prerequisites: None

020CGAGS1 General and Analytical Accounting 2 Cr.
This course familiarizes students with the different accounting documents, enabling them to establish the profit and loss accounts and the balance sheets. Moreover, they will determine the breakeven point as well as the distribution of expenses in fixed and variable. They will be able to draw up projected budgets and analyze the gaps with actual results. Finally, students will have in-depth knowledge of the different external stakeholders in the life of the company. Topics covered include: GENERAL ACCOUNTING: Standard documents (invoices, payment method, effect checks, etc.) - Balance sheet accounts - Income statement account - Elisa case (accounts in Te, income statement, balance sheet) - Case Crêperie Bretonne (recipe table, expenses, depreciation) - Case Pierre Berthoin (balance sheet and profit and loss account), profitability compared to turnover and capital - Case Segot Printing (sale of assets, relocation, provision). ANALYTICAL ACCOUNTING: Neutral (fresh fixed and variable allocation) - Motorex

case (operating table showing margin on variable expenses and profit) - SAPAG case (estimated budget and gap analysis). EXTERNAL STAKEHOLDERS: The State - The Bank - The Stock Exchange - Special financing (BOT, Concession, Syndic loans, ...).
Prerequisites: None

020PGCGS2 General Construction Procedures 4 Cr.
This course covers the main problems related to the execution of building construction projects. Topics covered include: Technical, financial and administrative analysis of the bidding documents - Management of projects in progress - Specifications and implementation techniques for civil engineering works from concrete to finishes - Construction machinery - Concrete components.
Prerequisites: None

020ECGGS1 General Economics 2 Cr.
This course aims to provide students with the necessary notions of microeconomics, focusing on the branch of the economy that analyzes economic behavior at the level of individual entities such as a consumer or a company.
Prerequisites: None

020GISGS3 Geographic Information Systems (GIS) 2 Cr.
The course introduces the possibilities of using GIS in the field of civil engineering, especially in the hydraulic and hydrology fields. It introduces the basic concepts of GIS: how to create, integrate and update geo-referenced data in vector and matrix modes; It introduces the spatial analysis principles applied to GIS, including tabular data querying, spatial queries, and layout and presentation functions.
Prerequisites: None

020GRDGS4 Graphic Design 2 Cr.
This course covers the essentials of graphic design.
Prerequisites: None

020HSOGS5 Groundwater Hydraulics 2 Cr.
This course provides the necessary elements to: quantify the groundwater flow in confined and unconfined aquifers; estimate the rates of seepage under dam structures; design and dimensioning of drills; interpret pumping tests; quantify solute and pollutant transport in simple configurations. Topics covered include: Introduction - Darcy’s law - Groundwater flow - Groundwater flow modeling - Field drilling methods - Pumping well hydraulics - Pollutant transport - Case study.
Prerequisites: None

020HYDGS3 Hydraulics 6 Cr.

This course focuses on steady-state and transient flows that include the design of simple and complex water distribution networks. Extended network analysis is undertaken by studying pumps and turbines. Free-surface flows complement the various flow aspects a civil engineer may encounter in practice. In addition to technical aspects, economic aspects are considered through various optimization methods. Topics covered include: Steady-State and Pressurized Networks – Turbomachines – Free surface flow - Unsteady Network Conditions in Pressurized Pipes - Network protection from water hammer effects - Network Economic Study and Optimization - Laboratory Experiments.

Prerequisites: Fluid Mechanics (020MEFGS2)

020HYDGS5 Hydrology 4 Cr.

This course is divided into two parts: climatology and hydrology. Climatology deals with the atmospheric mechanisms as well as qualitative and quantitative climate parameters. Hydrology is a fairly large field that covers measurements of a significant number of hydrological variables, as well as the analysis and quantification of terms related to conservation principles. Also, this part deals with extreme events and sheds light on hydrological modeling. Topics covered include: Introduction to climatology and hydrology - Principles of Meteorology - – Hydrologic Measurements – Rainfall Analysis – Watershed Delineation – Infiltration – Evaporation and Transpiration - Hydrographs – Flood Routing – Short Overview on Modeling

Prerequisites: Hydraulics (020HYDGS3)

020INDGS4 Industrial Construction 2 Cr.

The course consists of an interactive platform where the participation of students is continuous. It is enriched with examples supported by recent and less recent photos, short films and presentations, which reinforce theoretical notions already acquired. It also introduces a new dimension to the student engineer's approach to designing and executing a construction. Topics covered include: Introduction to the industrialization of concrete construction and prefabrication - Architectural design of a prefabricated construction - Structural design of a prefabricated construction plus annex: how to avoid the behavior in a castle of card during an explosion occurred in a building prefabricated) - Prefabrication methods - Joints between prefabricated components - Transport of prefabricated components - Assembly of prefabricated components - Components of prefabricated facades - Components of prefabricated floors - Examples of prefabrication systems - Example of a handling system - Introduction to prefabrication steel - Example of a component of the building industry: plasterboard is a revolution in the design of partitions.

Prerequisites: None

020AINGS4 Interior Architecture 2 Cr.

This course allows to approach the interior project through the following work methodology: selection of a theme, study the set of architectural movements that are most related to this theme and finally reach a materialization of a concept. Topics covered include: Exhibition and discussion of some projects that meet the course objectives - Exhibition of different themes and architectural movements - Choice of a relevant theme by each student and launching of the final project - Projection of some interior and exterior projects where the indoors / outdoors contrast is highlighted – Pin-ups and presentations- Final rendering of an A3 portfolio - Discussion and projection of the class' best projects.

Prerequisites: None

020IMAGS Introduction to Marketing 2 Cr.

This course introduces the students to basic principles of marketing.

Prerequisites: None

020IRRGS4 Irrigation 2 Cr.

This course aims to teach students about the importance of irrigation, plant behavior and irrigation practices. Topics covered include: Review of water cycle and importance of irrigation systems - Types of irrigation systems and machinery - Evapotranspiration and plants - Sprinkler irrigation - Irrigation and drainage - Irrigation in a Lebanese context.

Prerequisites: None

020HKAGS5 Karst Hydrogeology 2 Cr.

This course is about karst nomenclature and definitions, basic concepts for understanding karst development and related groundwater flows. Topics covered include: Introduction to methods in karst hydrogeology and geotechnical problems related to karst - Introduction to karst geology and geological notions - Introduction to methods in karst hydrogeology including hydrological, hydraulic, hydrochemical and isotopic/tracer methods - Karst hydrogeology of Lebanon - Introduction to groundwater modeling in karst environments.

Prerequisites: None

020MOGGS5 Market Globalization 2 Cr.

This course is divided into two parts and is intended for non-managers. It introduces basics of negotiation, especially through practical case studies and role plays to allow students better understand the subtleties and problems they will face in their professional lives. Topics covered include: Business Negotiations - Interpersonal communication - What is meant by negotiation - The method of business negotiations - The strategies for conducting a negotiation. Introduction to globalization. The international environment - The institutional framework of international exchanges - Globalization and new technologies - The international strategy of the company.

Prerequisites: None

020OUMGS5 Maritime Structures 2 Cr.
This course equips students with the basic elements to assess and analyze the seawater effects on the constituent elements of a port or a maritime structure. Topics covered include: Wave theory - Physico-chemical properties of seawater - Action of the sea on building materials - Principles of setting up a seaport - External works of the ports - Inner works of the ports - Docking works - Tools of the maritime ports - Clearance of the channels of access of the ports and the water bodies. Dredging-Drills; Bailout wreck.
Prerequisites: Foundation Engineering (020FOSGS3)

020PBAGS4 Multidisciplinary Project: Building Design, Foundations and Structures 6 Cr.
This course covers the design of foundations and structural elements of reinforced concrete building. Topics covered include: Calculation of the foundations of a building - Calculation of the structure and dimensioning of the structural elements of a reinforced concrete building.
Prerequisites: Reinforced Concrete (020BEAGS3) and Architecture Project (020PARGS1)

020ANNGS1 Numerical Analysis 4 Cr.
This course aims at providing students with the numerical tools and computational techniques to solve the equations and models encountered in the field of Civil Engineering. Topics covered include: General introduction to numerical methods - Approximation and interpolation - Numerical integration - Numerical derivation - Numerical resolution of differential equations - Systems of linear equations - Equations and systems of nonlinear equations - Methods of calculating eigenvalues- Partial derivative equations.
Prerequisites: Calculus 2 (020AN2NI4 or 020AN2CI3), and Bilinear Algebra and Geometry (020ALBNI3) or Algebra 2 (020AL2CI3)

020PLGGS5 Planning and Management of Large-Scale Projects 4 Cr.
This course aims to introduce students to the concepts of project management, the content of the contractual management documents, as well as the methodology for preparing a complete set of tender documents. Topics covered include: General introduction - Administrative management - Quality management - Cost management - Time management - Presentation and discussion of student projects - What is a project - What is planning a project - How to develop a project - Running the schedule - Target and progress - Allocation of resources and costs - Layouts and fitters.
Prerequisites: None

020PLCGS5 Plates and Shells 4 Cr.
This course covers the theoretical elements needed to pre-dimension and analyze structural elements such as slabs, walls, roof, tanks and folded structures. Topics covered include: General introduction on plates and shells - Kirchhoff’s theory of plates - Bending theory of rectangular plates - Bending theory of circular plates - Theory of shells - Membrane theory of shells of revolution - Bending theory of shells of revolution - Junction of shells of revolution.
Prerequisites: Structures (020STRGS4)

020BPRGS5 Prestressed Concrete in Buildings 2 Cr.

This course covers the basic principles of the behavior of prestressed concrete structures with a focus on building applications. Topics covered include: Definition - Concept - History - Advantages - Materials (Concrete, Steels) - Processes and systems – Pre-stressing losses - Principles of calculation.

Prerequisites: Reinforced Concrete (020BEAGS3)

020BEPGS5 Prestressed Concrete 4 Cr.

This course provides the necessary elements to understand and design the Prestressed Concrete Structure. Topics covered include: Historical View of Prestressed Concrete - Different Procedures of Prestressed - Losses Calculation of Prestressed cables - Flexure in Service and Ultimate Design of Prestressed Concrete - Shear Design - Material characteristically and behavior - Composite Beams design - Hyperstatical system: Continuous beams and Post-Tensioning bridges exercises.

Prerequisites: Reinforced Concrete (020BEAGS3)

020PUBGS4 Public Speaking 2 Cr.

This course aims to enhance the knowledge of students in the field of Public Speaking through real cases and examples.

Prerequisites: None

020PECGS4 Protection and Aesthetics of Buildings 2 Cr.

This course addresses the protection and aesthetic aspects of constructions, especially paints, sealing problems, and more. Topics covered include: The elements of mixing water and their influence on buildings - Admixtures - Cemented products - Protective products and applications - Aesthetics (Painting and decorative products) - Plastic products (electrical - heating - expansion joints ...)

Prerequisites: None

020QUAGS3 Quality Management in Buildings 2 Cr.

This course introduces students to quality in management systems and particularly in the field of construction where risk, safety and economic issues are important. Topics covered include: Introduction - Quality management systems - Quality assurance in construction (ISO, ...) - Codes and standards - European requirements (especially construction products) - Quality chain in the construction industry - Technical inspection - Procedures and quality manual - Economic and technical impact of non-quality - Statistics - Site visit - The necessary improvement of quality in the construction industry - Prevention / correction - Building pathologies - Practical examples - Real cases.

Prerequisites: None

020COCGS5 Rehabilitation and Design of Concrete Bridges 4 Cr.

The course provides the necessary information for designing the various types of bridges. It examines the causes of disorders of existing bridges and the techniques used for their repair and reinforcement. Topics covered include: Generalities -Functional data - Bridge equipment -

Traffic load calculations - Distribution of horizontal forces on supports - Piers and abutments - Steel bridges -Reinforced and prestressed concrete bridges - Precast prestressed concrete bridges - Girder bridges - Suspension bridges - Cantilever bridges - Rehabilitation and reinforcement of concrete bridges - Bridge monitoring and maintenance
Prerequisites: Structures (020STRGS4)

020REMGS5 Rehabilitation and Maintenance of Concrete Structures 4 Cr.
This course provides the necessary baggage for the establishment of a rehabilitation operation or transformation of the building structure by the various investigation and consolidation processes with the development of cases of completed projects. Topics covered include: Introduction: Maintenance - Rehabilitation - Modification-Reinforcement - Choice of policy to follow: cost-Internet - Nature and type of building (Historic building in masonry - Old building: masonry + concrete - Building in reinforced concrete - Building in steel structure) - Processes and phases to follow (Diagnosis - Rehabilitation Project) - Development of completed projects.
Prerequisites: None

020BEAGS3 Reinforced Concrete 6 Cr.
This course consists of dimensioning reinforced concrete structural elements according to BAEL and Eurocode 2. Topics covered include: Introduction - General - Bases of semi-probabilistic calculation - Evolution of calculation methods for reinforced concrete - Characteristics of materials - Durability and Coating - Adherence - Constructive provisions - Theory of cracking - Simple traction - Study of columns - Simple compression - Composite bending - Study of beams - Simple bending - Shear force - Study of beams - Torsion - Seismic arrangements - Practical work: Strength of concrete (Mechanical compression - Sclerometer - Pundit) - Test Los Angeles - Determination of concrete - Cleanliness of sand ...
Prerequisites: Strength of Materials (020RDMGS2)

020ROUGS4 Road and Pavement Engineering 4 Cr.
This course explains how to draw a road and design its roadways. Topics covered include: Vehicle movement - Plan drawing - Longitudinal profile - Cross section - Road equipment - Safety devices - Signing - Night traffic, lighting - Drainage devices, drainage - City roads - Crossroads - Calculation of curvatures - Initiation to the layout on computer. - Road geotechnics - Surface qualities of pavement - Pavement design, calculation of thicknesses - Basic materials - Aggregates - Binders - Surface layers, asphalt mix - Road construction - Pavements - Superficial coatings - Rigid pavements, cement concrete pavements. - CBR test - Softening test - Penetration test - Ductility test - Accelerated polishing test and friction pendulum.
Prerequisites: None

020RCGGS5 Shear Strength and Geohazards 4 Cr.
Key topics include: Understand influence factors and plan the measurement of soil shear strength under static and cyclic loading modes; Understand the basis of soil rheology; Introduce the notions of the effect of earthquakes on soils in terms of failure mode; Analyze landslide problems in terms of slope stability, excavations and embankments. Apply

geotechnics to environmental problems; Identify the nature of contaminants in the soil with their biological, chemical and physical properties; Understand the modes of transport of contaminants in order to calculate their concentration in time and space; Develop treatment methods for soil decontamination; Design landfills.
Prerequisites: Foundation Engineering (020FOSGS3)

020MESGS2 Soil and Rock Mechanics 6 Cr.
Key topics include: Understand the behavior of the soil material. Identify the physical properties, the mineralogical and chemical composition of the porous medium. Understand the theory of soil compaction. Introduce the notions of pore pressure and effective stress. Identify the hydraulic properties of soils. Draw the water flow networks. Understand consolidation and calculate soil compaction. Understand the Mohr-Coulomb criterion. Introduce the concepts of shear resistance and geo-environment.
Prerequisites: Geology (020GELNI4 or 020GELCI4)

020DESGS5 Solid Waste Management 2 Cr.
This course addresses municipal solid waste problems and treatment methods. Topics covered include: Sources, quantities generated and properties of municipal solid waste - Municipal waste collection techniques - Public road cleaning techniques - Municipal waste disposal techniques: landfilling and incineration - Waste recycling and re-usage (composting, glass/plastic/paper re-use, etc…) - Waste disposal costs - Industrial and medical waste collection and treatment.
Prerequisites: None

020OSPGS5 Special Topics in Concrete 2 Cr.
This course covers the design of special concrete structures including: Short consoles - Beams partitions - Mixed structures - Walls of resurfacing - Water tanks - Cap - Industrial chimneys - Silos - Floors - Slabs – Cylindrical shells - Caissons.
Prerequisites: Reinforced Concrete (020BEAGS3)

020HYSGS5 Statistical Hydrology 4 Cr.
This course provides the necessary elements to: determine and fit probability distributions and models to univariate and multivariate hydrologic variables, perform statistical tests and frequency analysis, select extreme value distributions and estimate probable maximum or minimum events (precipitation, droughts and floods). Topics covered include: Statistical analysis of hydrological data - Graphical representation of data - Extreme values of a variable - Correlatory analysis - Simple regression and multiple regression - Statistical tests in hydrology - Statistical study of rainfall - Frequency analysis - Example of statistical model in hydrology.
Prerequisites: Statistics (020STAGS2)

020STAGS2 Statistics 4 Cr.
This course introduces students to basic statistics. Topics covered include: Central limit theorem - sampling distributions - qualities of the estimators - Estimation by confidence

intervals - estimation by the maximum likelihood method - estimation by the moments method - tests of parametric hypotheses - Linear regression (simple and multiple) - tests of non-parametric hypotheses - bootstrap - introduction to Bayesian statistics - Monte Carlo method - Monte-Carlo methods by Markov chains (MCMC) - approximate Bayesian calculation (ABC).
Prerequisites: Probability (020PRBNI4) or Algebra 3 (020AL3CI4)

020CMMGS3 Steel Structures 6 Cr.
Metallic and mixed construction is one of the most widespread and expanding construction methods in Lebanon. The objective of this course is to design and dimension the structural elements of a building or a metal or mixed structure according to CM66 and Eurocodes 3 and 4 regulations. Topics covered include: General overview- Components of a metal building structure - Poles - Farms and beams - Floors - Framing walls and partitions - Cover - Connections – Applications. Calculation and sizing. Regulation aspect CM66, EC3 and EC4 - Calculation of solid core and truss posts. Buckling. Calculation of solid core and truss beams – Spill. Calculation of overhead cranes and monorails - Calculation of a roof failure. Calculation of rails - Calculation of joints; bolting, welding - Study of bracing - Study of an industrial building or a residential building.
Prerequisites: Strength of Materials (020RDMGS2)

020RDMGS2 Strength of Materials 6 Cr.
This course enables students to understand the behavioral law of the materials, calculate and analyze the characteristics of the cross sections, as well as distribute the internal efforts and stresses in the different elements of 2D structures and the deformations of these elements. Topics covered: Theory of beams – Characteristics of the cross section - Center of Gravity - Moment of inertia – Normal effort - Bending - Torsion - Shear – Combined loadings - Calculation of the critical load of a structure: Theory of Euler - Energy theorems: Clapeyron, Maxwell-Betti, Bertrand de Fonviolant, virtual works, Castigliano, Menabrea - Force method - Three moments method.
Prerequisites: Continuum Mechanics (020MMDGS1)

020DYSGS5 Structural Dynamics and Earthquake Engineering 4 Cr.
This course equips students with the necessary elements to understand the dynamics of the structures and size them to withstand earthquakes according to the PS92 regulation. Topics covered include: Earthquakes - Single Oscillator - Multiple Oscillator - Response of a structure to an earthquake - Calculation from an accelerogram - Calculation from a response spectrum - Regulatory aspects - Structural modeling - Seismic design - Rules PS92: Design, calculation and construction - Applications - Study of some works according to PS92.
Prerequisites: Waves Physics (020PHONI3)

020STRGS4 Structures 6 Cr.
This course covers structural forms; influence lines; effects of temperature loads on structures, analysis of arches, trusses, continuous beams, 2D frames, grids and 3D frames. Topics covered include: Calculation of 2D structures (Rotation Method and Hardy-Cross Method) - Study of Arcs - Study of 3D structures - Method of displacements - Study of the stability of structures -

Study of influence, use of lines of influence and applications - Beams on elastic supports - Beams on elastic soil - Study of the effect of temperature on structures – Software applications.
Prerequisites: Strength of Materials (020RDMGS2)

020PLSGS4 Structures Plastic Behavior 2 Cr.
This course equips students with the basic elements of plasticity, currently used in the new calculation codes in civil engineering. Topics covered include: Generalities on plasticity calculation and plasticity criteria, Plastic traction and Compression, Plane plastic bending and notion of plastic hinge, Plastic resistance of sections in the presence of interaction between the internal forces - Calculation of the collapse load of statically indeterminate structures: Using the step-by-step method, Using the theorems of limit analysis.
Prerequisites: Strength of Materials (020RDMGS2)

020ACTGS2 Structural Load Calculations 4 Cr.
This course aims to study and analyze the basis of structural design including the evaluation and analysis of vertical loads, snow and wind on structures as well as the appropriate consideration of different combinations of actions. Topics covered include: Introduction - Verification by the partial factor method - Serviceability and Ultimate limit states - Classification of Actions - Combination of Actions - Snow load - Wind load.
Prerequisites: None

020LOCGS5 Structural Software 2 Cr.
This course presents the modeling and calculation of structures by finite elements using software: Robot Autodesk, ETABS, SAFE, CSI bridge. Topics covered include: Study of plane and spatial portal frames, Study of plates and shells, Study of a bridge, Seismic analysis of a building founded on a general raft.
Prerequisites: None

020STEGS5 Summer Internship 4 Cr.
Students will undertake their first work experience in a professional environment, namely design offices and construction sites. This internship lasts 8 weeks.
Prerequisites: None

020STOGS1 Surveying 2 Cr.
This course covers the use of topographic material for field surveys, and the operation of topographic equipment: tachometer, theodolite, level, prism square, workstation.
Prerequisites: Topography (020TOGNI4)

020TRAGS3 Traffic Engineering 2 Cr.
Students will study and analyze the road traffic of a region, and the different elements and functions of a road or highway. Topics covered include: The different elements and functions of a road or highway - Road traffic - Transport demand and supply - Economic and institutional context - Comparison of modes of transport - Priority to public transport in large cities - Environmental impacts.

Prerequisites: None

020AERGS3 Transport and Airport Engineering 2 Cr.
This course provides students with a systematic approach to essential structures in airport design. It addresses all the necessary topics or a civil engineer can intervene for a better exploitation, that it is at the level of the airport platforms or within the airline companies. At the end of this course, students will be able to sizing an aerodrome or undertaking its execution. On the other hand, they will also be familiar with aviation operations. Topics covered include: Airport Panorama - Aerodrome Information - Physical Characteristics of the Track and Traffic Tracks - Aeronautical Clearances - Aeronautical Pavements - Freight Stations - Hangars and Specialized Areas - Control Towers and Technical Blocks - Radio and Meteorological Aids - Beaconing of the Day and Lighting Signage - Traffic - Drainage - Maintenance of the Airfield - Visit Beirut International Airport.
Prerequisites: None

020AVTGS4 Urban and Landscape Planning 2 Cr.
This course covers urban planning rules.
Prerequisites: None

020ASSGS4 Urban Drainage 2 Cr.
This course covers the design of urban sanitation networks. Topics covered include: Survey of urban planning (Topographic - Cadastral - Geological - Climatic) - Rainwater (Watershed - Statistical study of precipitation - Impoundment, Storm weirs) - Abacuses and formulas - Wastewater (Analysis - Curve of flow, tips - Evacuation: study of networks - Longitudinal profiles - Drawing in plan - Obstacles - Structures) - Symbols, Written documents.
Prerequisites: Hydraulics (020HYDGS3)

020GEPGS5 Water and Wastewater Treatment 4 Cr.
This course examines the methods of water and wastewater treatment. Topics covered include: Water: Characteristics, constituents, impurities - Types of water to be treated and why - Physico-chemical processes for water treatment - Biological processes for water treatment – Sludge - Potable water treatment streams – Typical treatment plants - Waste water treatment streams – Typical treatment plants.
Prerequisites: None

020DEAGS3 Water Distribution Networks 4 Cr.
This course introduces the water management process, focusing on the relationship between natural water and water treatment. It provides essential information for modeling, dimensioning, scenario simulation and the choice of equipment needed to provide citizens with sufficient water and adequate pressure. Topics covered include: Water transport cycles - Estimation of the populations to be served - Volumes and flows of drinking water - Collection, supply and distribution of water - Flows needed to fight fires - Existing pipes on the market - Accessory organs - Stops and fasteners - Hydraulic characteristics of flows in water distribution

pipes - Design and modeling of a drinking water distribution network - Water distribution for irrigation projects.
Prerequisites: None

BACHELOR OF ENGINEERING IN COMPUTER AND COMMUNICATIONS ENGINEERING

Main Language of Instruction:

French: ◙	English: ◙	Arabic: □

Campus where the Program is Offered: CST

Objectives

The Bachelor of Engineering in Computer and Communications Engineering aims to graduate students able 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 together 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

180 credits: Required courses (146 credits), Institution’s elective courses (30 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits – may be part of the above categories).

Fundamental Courses

Required Courses (146 Cr.)
Accounting (4 Cr.)
Analog and Digital Communications (6 Cr.)

Analog Electronics (6 Cr.)
Business Ethics (4 Cr.)
Business Law (2 Cr.)
Communication Skills (2 Cr.)
Data Structure and Algorithms (4 Cr.)
Digital Electronics (6 Cr.)
Graph Theory and Operational Research (4 Cr.)
Innovation and Design Thinking (2 Cr.)
Introduction to Data Networks (6 Cr.)
Management (2 Cr.)
Network Routing and Switching (4 Cr.)
Object-Oriented Programming (6 Cr.)
Project Management (4 Cr.)
Relational Databases (4 Cr.)
Signal Theory (4 Cr.)
Statistics (4 Cr.)
Unix System Administration (4 Cr.)

For the Artificial Intelligence Option:
Artificial Intelligence (4 Cr.)
Computer Architecture (4 Cr.)
Computer Vision (4 Cr.)
Generative AI (4 Cr.)
Machine Learning (4 Cr.)
Machine Learning Operations (4 Cr.)
Mining Massive Datasets (4 Cr.)
Natural Language Processing (4 Cr.)
NoSQL Databases (4 Cr.)
Optimization for AI (4 Cr.)
Parallel Programming (4 Cr.)

For the Software Engineering Option:
Analysis and Design of Information Systems (4 Cr.)
Artificial Intelligence (4 Cr.)
Compiler Principles (4 Cr.)
Computer Architecture (4 Cr.)
Computer Virology (4 Cr.)
Design Patterns (4 Cr.)
Distributed Applications (4 Cr.)
Enterprise Application Integration (4 Cr.)
Operating Systems (4 Cr.)
Parallel Programming (4 Cr.)
Software Engineering (4 Cr.)

For the Telecommunication Networks Option:

Digital Signal Processing (4 Cr.)
Information Theory and Coding (4 Cr.)
Microprocessor Systems (4 Cr.)
Mobile Networks (4 Cr.)
Network Engineering (4 Cr.)
Optical Systems and Networks (4 Cr.)
Performance of Computer Systems and Networks (4 Cr.)
Quality of Service in Networks (4 Cr.)
Secured Enterprise Networks (4 Cr.)
Waveguides and Antennas (4 Cr.)
Wireless Communications (4 Cr.)

Corporate Internships (2 Cr.) – During their studies, students can complete two internships:

- A recommended labor internship of at least 4 weeks at the end of the third year of studies.
- A mandatory technical internship of 6 to 10 weeks at the end of the fourth year of studies (2 Cr.).

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.

Final Year Project (16 Cr.)

The final year project is carried out in groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval 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.

Institution’s Elective Courses (30 Cr.). Six courses are to be selected from the mandatory courses of the two other options, or from those listed below:

Advanced Databases (4 Cr.)
Advanced Microcontroller Systems (4 Cr.)
Advanced Networking and WAN technologies (4 Cr.)
AI in Marketing (4 Cr.)

Blockchain and Cryptocurrency (4 Cr.)
Cloud and Digital Transformation (4 Cr.)
Continuous Integration and Deployment (4 Cr.)
Cryptography (4 Cr.)
Effective Programming (4 Cr.)
Embedded Systems (4 Cr.)
Entrepreneurship (2 Cr.)
Ethical Hacking (4 Cr.)
Functional Programming (4 Cr.)
Information Security - Standards and Best Practices (4 Cr.)
Information Technology (IT) at Work (4 Cr.)
Internet Ecosystem and Evolution (4 Cr.)
Internet of Things Technologies (4 Cr.)
Introduction to Data Science (4 Cr.)
Microwave Links and Circuits (4 Cr.)
Mixed-Signal IC Design (4 Cr.)
Mobile Applications Development (4 Cr.)
Numerical Methods (4 Cr.)
Operator Networks Infrastructure (4 Cr.)
Printed Circuit Board Design Fundamentals (4 Cr.)
Space and Micro/Nano Satellite Technologies (4 Cr.)
Virtualization (4 Cr.)
Web Programming (4 Cr.)
Windows System Administration (4 Cr.)
Work Ready Now (2 Cr.)

For the program taught in French:
English (4 Cr.)
For the program taught in English:
An additional institution's elective course (4 Cr.)

Open Elective Courses (4 Cr.)
One open elective course: Arabic Culture and Language (2 Cr.)
One open elective course (2 Cr.)

USJ General Education Program (26/36 Cr.)

10 additional credits are earned at the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGES4	*For the program taught in French:* English *For the program taught in English:* An additional institution's elective course	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 Courses Taught in Arabic	***2***
020DRAES5/020BULES5	Business Law	2
	HUMANITIES	**4**
	Ethics	***4***
020ETHES3/020BETES3	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 Courses	***4***
020GPRES2/020PMGES1	Project Management	4
	COMMUNICATION TECHNIQUES	**8**
020TCOES2/020CSKES2	Communication Skills	2
020PRMES4/020MDPES4	Multidisciplinary Project	2 out of 6
020PFEES6/020FYPES6	Final Year Project	4 out of 16

Suggested Study Plan

Semester 1

Code	**Course Name**	**Credits**
020ELAES1/020AELES1	Analog Electronics	6
020INRES1/020IDNES1	Introduction to Data Networks	6
020CPPES1/020OOPES1	Object-Oriented Programming	6
020GPRES2/020PMGES1	Project Management	4
020THSES2/020STHES1	Signal Theory	4
020STAES1/020STTES1	Statistics	4
	Institution's Elective course	2
	Total	**32**

Semester 2

Code	**Course Name**	**Credits**
020CONES3/020ADCES2	Analog and Digital Communications	6
020TCOES2/020CSKES2	Communication Skills	2

020ELNES2/020DELES2	Digital Electronics	6
020TROES2/020GTOES2	Graph Theory and Operational Research	4
020RCOES2/020NRSES2	Network Routing and Switching	4
020BDRES2/020RDBES2	Relational Databases	4
020ADUES3/020USAES2	Unix System Administration	4
	Open Elective: Arabic Language and Culture	2
	Total	**32**

Semester 3

Code	**Course Name**	**Credits**
020ETHES3/020BETES3	Business Ethics	4
020SDAES3/020DSAES3	Data Structures and Algorithms	4
020INDES2	Innovation and Design Thinking	2
 020IA2ES4/020AINES3 020AROES3/020CARES3 020NLPES3 020NQLES3	*For the Artificial Intelligence Option (16 Cr.)* Artificial Intelligence Computer Architecture Natural Language Processing NoSQL Databases	 4 4 4 4
 020ADPES3/020ADIES3 020IA2ES4/020AINES3 020AROES3/020CARES3 020MCOES3/020DPAES3	*For the Software Engineering Option (16 Cr.)* Analysis and Design of Information Systems Artificial Intelligence Computer Architecture Design Patterns	 4 4 4 4
 020TNSES3/020DSPES3 020SMPES3/020MPSES3 020PGAES3/020WGAES3 020CSFES3/020WICES3	*For the Telecommunication Networks Option (16 Cr.)* Digital Signal Processing Microprocessor Systems Waveguides and Antennas Wireless Communications	 4 4 4 4
	Institution's Elective courses	8
	Total	**34**

Semester 4

Code	**Course Name**	**Credits**
020PRMES4/020MDPES4	Multidisciplinary Project	6
 020CVNES4 020MLRES4 020MMDES4	*For the Artificial Intelligence Option (12 Cr.)* Computer Vision Machine Learning Mining Massive Datasets	 4 4 4
 020PCOES4/020CPRES4 020APDES4/020DAPES4 020SSEES4/020OPSES4	*For the Software Engineering Option (12 Cr.)* Compiler Principles Distributed Applications Operating Systems	 4 4 4

  020REMES4/020MONES4 020SYOES4/020OSNES4 020PSRES4/020PCSES4	*For the Telecommunication Networks Option (12 Cr.)* Mobile Networks Optical Systems and Networks Performance of Computer Systems and Networks	 4 4 4
020ANGES4	*For the program taught in French:* English *For the program taught in English:* An additional institution's elective course	4
	Open Elective	2
	Institution's Elective courses	8
	Total	**32**

Semester 5

Code	**Course Name**	**Credits**
020CMPES5/020ACNES5	Accounting	4
020DRAES5/020BULES5	Business Law	2
020STGES5/020CRPES5	Corporate Internship	2
020MNGES5	Management	2
 020GAIES5 020MLOES5 020OAIES5 020PPLES5/020PPRES5	*For the Artificial Intelligence Option (16 Cr.)* Generative AI Machine Learning Operations Optimization for AI Parallel Programming	 4 4 4 4
 020VIRES5/020CVRES5 020IAEES5/020EAIES5 020PPLES5/020PPRES5 020GLOES5/020SOEES5	*For the Software Engineering Option (16 Cr.)* Computer Virology Enterprise Application Integration Parallel Programming Software Engineering	 4 4 4 4
  020TICES5/020ITCES5 020IDRES5/020NENES5 020QOSES5/020QSNES5 020RESES5/020SENES5	*For the Telecommunication Networks Option (16 Cr.)* Information Theory and Coding Network Engineering Quality of Service in Networks Secured Enterprise Networks	 4 4 4 4
	Institution's Elective course	8
	Total	**34**

Semester 6

Code	**Course Name**	**Credits**
020PFEES6/020FYPES6	Final Year Project	16
	Total	**16**

Course description

020CMPES5/020ACNES5 Accounting 4 Cr.
Definition of accounting, accounting process, accounting concepts, classification of accounts, rules of double entry accounting system, rules of journal, current assets, current liabilities. concepts of cost accounting, advantages of cost accounting, classification and elements of cost, preparation of cost sheet.

020BDAES3/020ADDES3 Advanced Databases 4 Cr.
This course explores advanced concepts and techniques in database systems, building on foundational knowledge of relational databases. Students will gain in-depth understanding and practical skills in database design, optimization, transaction management, and security. Emphasis is placed on enhancing the performance, integrity, and reliability of database systems through advanced methodologies and tools.
Prerequisite: Relational Databases (020BDRES2/020RDBES2).

020SAMES4/020AMSES4 Advanced Microcontroller Systems 4 Cr.
Introduction to embedded systems – Introduction to STM32 family of MCUs and STM32CubeIDE – Principles of schematic interpretation for embedded applications – Overview and practical exploration of MCU Peripherals: ADC, DAC, Advanced Timers, PWM, UART, I2C, SPI, DMA, SDIO, USB – Introduction to Real Time Operating System (RTOS) – Introduction to machine learning on MCUs and TinyML.
Prerequisite: Microprocessor Systems (020SMPES3/020MPSES3).

020RLIES4/020WANES4 Advanced Networking and WAN Technologies 4 Cr.
This course covers the third and fourth semesters of the Cisco CCNA Routing & Switching curriculum. It focuses on the architecture, components and operation of routers and switches in a larger and more complex network by presenting the configuration of this equipment for advanced functionality. Emphasis is also placed on WAN technologies and network services required by converged applications in a complex network, providing an understanding of network device selection criteria and WAN technologies that meet network requirements.
Prerequisite: Network Routing and Switching (020RCOES2/020NRSES2).

020AIMES5 AI in Marketing 4 Cr.
This course explores the integration of artificial intelligence tools and techniques in modern marketing practices. Students will delve into the utilization of AI algorithms, machine learning models, and data analytics to optimize marketing strategies across various digital channels. Through real world applications and hands on experience, students will learn to personalize content, enhance customer engagement, and drive ROI through targeted advertising and dynamic pricing. The course emphasizes ethical considerations and responsible AI usage, empowering marketers to leverage technology effectively while maintaining integrity and trust.

020CONES3/020ADCES2 Analog and Digital Communications 6 Cr.

Narrow band signals – linear modulations: AM, Double Side Band, Single Side Band – Frequency modulation: Spectrum, Modulator, Demodulator, Phase Locked Loop – Performance in presence of Noise – Digital communications system – Pulse Amplitude Modulation – QAM, PSK, ASK, MSK, GMSK modulations – Coherent Reception of linear modulations – Base band and narrow band models of a digital communication system – Inter Symbol Interference – Eye diagram – Nyquist channel – performance of linear modulations over a Nyquist channel – Reception in presence of ISI – Equalization: Linear, DFE, MSE – Mobile and selective channels – OFDM modulation - performance of digital modulations over a Rayleigh flat fading channel – Diversity – MIMO channels – Alamouti scheme – Carrier and time synchronization: Differentially coherent reception – Squaring method – Costas Loop.
Prerequisite: Signal Theory (020THSES2/020STHES1).

020ELAES1/020AELES1 Analog Electronics 6 Cr.

This course covers the main low-power electronic components: 1) P-type and N-type semiconductors – P-N junction; 2) diodes: characteristics and application circuits (clipping, rectification, etc.), Zener diode (regulation), Light-emitting diode. 3) Bipolar transistor: DC operation (I-V characteristics, Biasing, Load line), AC operation (amplifier circuits), synthesis of amplifier circuits, Bipolar transistor as switches. 4) MOSFET transistors: I-V characteristics, resistive operation and amplification. 5) Operational amplifier (OA): behavioral model and imperfections, application circuits (Inverting/Non-inverting amplifiers, Integrators, Voltage Follower, Active filters). 6) Comparator: characteristics, performance & limitations, applications.
Prerequisite: Linear Electrical Systems and Networks (020SRLNI4/020LESNI4 or 020SRLCI4).

020ADPES3/020ADIES3 Analysis and Design of Information Systems 4 Cr.

I.S (information systems) in the company. Data Analysis - Data Modeling - Merise Methodology - Static Model - Dynamic Model - Data Flow Diagram - Data Conceptual Model - Data Logic Model - Passage Rules - Conceptual Model of Treatments - Logic Model of Treatments - MCD, MCT, MLD, MOT, MPD, MoPT - Extension Merise 2.

020ANGES4 Anglais 4 Cr.

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

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.

020IA2ES4/020AINES3 Artificial Intelligence 4 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. We first cover greedy and A* search, the implementation of games through the Minimax and Expectimax algorithms, Markov Decision Processes (MDP) and Reinforcement Learning (RL). We then introduce Machine Learning (ML) algorithms with some applications.
Prerequisite: Graph Theory and Operational Research (020TROES2/020GTOES2).

020BLOES3 Blockchain and Cryptocurrency 4 Cr.
The Blockchain Technology course offers a comprehensive foundation in blockchain systems, cryptocurrencies, decentralized applications (DApps), and consensus mechanisms. It blends theoretical concepts with hands-on experience to equip students with practical skills relevant to blockchain development and application. Students will explore core cryptographic principles, blockchain structure, smart contracts, and real-world use cases in finance, supply chain, and more.

020ETHES3/020BETES3 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. The course is aimed at students destined to work in public or private companies and in all fields. Its objective is to create awareness for the need of 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 it.

020DRAES5/020BULES5 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.

020CLDES5/020CDTES5 Cloud and Digital Transformation **4 Cr.**
A panorama of Cloud technologies and industry, and its positioning into the IT landscape. What are the fundamentals of the Cloud and how it disrupts the way IT is purchased, consumed and operated. What is the definition of the Cloud, how is that different from traditional IT technically, economically, organizationally and for business efficacy and innovation.
Who are the players and what are 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 Cloud.

020TCOES2/020CSKES2 Communication Skills **2 Cr.**
Communication is of high importance for an engineering student. Indeed, whether in academic or professional activities, transmitting information is a powerful tool for convincing and even influencing. Communication is unavoidable, but it includes many errors and risks to be avoided. Otherwise, the reception of the information may be disturbed and misunderstood. This course offers students the knowledge of essential basic rules of main means of communication (written, verbal and non-verbal) and making them aware of the errors to be avoided.

020PCOES4/020CPRES4 Compiler Principles **4 Cr.**
Introduction to compilers – Lexical analysis: A language for specifying lexical analyzers, Finite automata, Design of a lexical analyzer generator, LEX tool. Algebraic grammar and pushdown automata – Syntax analysis: Top-down parsing and LL parsers, Bottom-up parsing and LR parsers, Parser generators and YACC tool – Semantic analysis: Syntax-directed definitions, Bottom-up evaluation, Top-down translation – Intermediate code generation: Three-address code, code optimization.

020AROES3/020CARES3 Computer Architecture **4 Cr.**
This course explores the fundamental principles of computer architecture and organization, focusing on how computers are structured, how they process information, and how performance is optimized. Topics include the evolution of computer systems, performance metrics, and the Von Neumann model. The course examines key components such as interconnection structures, memory hierarchies, and input/output systems. Students will study instruction set architectures (ISA), processor structure and functions, and advanced concepts such as pipelining, RISC and CISC architectures, instruction-level parallelism (ILP), and superscalar processing. The course also introduces parallel architectures and organizational strategies used to enhance computational performance in modern systems.
Prerequisite: Digital Systems Design (020TEDNI4/020DSDNI4 or 020TEDCI4).

020VIRES5/020CVRES5 Computer Virology 4 Cr.
Introduction: The taxonomy of malware and its capabilities, History of malware – Reverse engineering: tools, obfuscation, packers, anti-debug techniques, x86 and x64 Assembly, Binary Code Analysis – Buffer overflows: Memory Corruption Bugs, Stack Overflow, Format String Attack, Integer Overflow, Fuzzing, Exploitation and Mitigation Techniques, Protection Mechanisms – The theory of malware: Turing Machine, The Halting Problem and Decidability, Adleman's proof of the undecidability of the presence of a virus, Cohen's experiments on detectability and self-obfuscation – Self-reproducing Malware: script and macro-virus, executable file virus, system virus and rootkit, Antivirus: Antivirus techniques, Antivirus Relay, Protection techniques, Antivirus Benchmarking and Testing – SPAM: Common techniques of SPAM and SPAM filtering.

020CVNES4 Computer Vision 4 Cr.
This course introduces students to the fundamental principles and practical techniques of computer vision. Topics include image filtering, feature extraction, edge detection, geometric transformations, object detection, segmentation, and 3D vision. Students will also explore modern deep learning-based approaches such as convolutional neural networks (CNNs), Vision Transformers (ViTs), object detection models (YOLO, SSD), and convolutional autoencoders (CAEs) for dimensionality reduction and denoising. Applications span image classification, depth estimation, and video analysis. Through hands-on labs and projects using Python and libraries like OpenCV, PyTorch, and Scikit-image, students will develop the skills to build, evaluate, and deploy computer vision systems.
Prerequisite: Signal Theory (020THSES2/020STHES1).

020IDCES5/020CIDES5 Continuous Integration and Deployment 4 Cr.
This DevOps course provides a thorough overview of DevOps principles, practices, and key tools, offering a comprehensive understanding of the software development lifecycle (SDLC). Students will learn about DevOps fundamentals, containerization, continuous integration pipelines, and Infrastructure as Code (IaC) using technologies such as Docker, GitHub Actions, Jenkins, Ansible, and more. A semester-long project will allow practical application of concepts learned in class. Upon completion, students will be well-prepared for careers in software development and IT operations.

020STGES5/020CRPES5 Corporate Internship 2 Cr.
The internship is a training modality that allows the student to apply the knowledge acquired during their studies in a professional setting. It enables the development of professional skills that complement theoretical and practical training, offers experience in human relations typical of the various environments where engineers work, provides an opportunity to gain knowledge that only the workplace can offer, and helps acquire experience and competencies that facilitate future employment.

020CRYES4/020CTGES4 Cryptography 4 Cr.
Introduction to threats and attacks – services: authentication, integrity, confidentiality, non-repudiation – security mechanisms and technics: algorithms, smart cards, key management, certificates, etc. – recommendations and law – security protocols: PKCS, PKI, X509, SSH,

ISO9735, SSL, S/Mime – API – practical cases: e-banking, e-commerce, e-notary, health, archeology, etc.

020SDAES3/020DSAES3 Data Structures and Algorithms 4 Cr.

Complexity analysis, Elementary data structures (Arrays, Linked lists, stacks, queues), Search problems (sequential search, bisection), Sorting (elementary sorts, quicksort, merge sort), trees (characteristics, structure, traversal), string search algorithms, priority queues, heap, graphs (characteristics and structure), graph algorithms (shortest path, spanning tree, connectivity, etc.), scheduling problems, flow problems (maximum flow, minimum cost flow problem, etc.), coupling, dynamic programming.

020MCOES3/020DPAES3 Design Patterns 4 Cr.

This course covers the principles of Object-Oriented Programming in Java. It details the 23 design patterns of the book: Design Patterns: Elements of Reusable Object-Oriented Software (GOF) and shows how and when to use creational/structural/behavioral design patterns in a greenfield project or in refactoring a brownfield project. It introduces the UML modeling language for modeling object-oriented solutions as well as covering the main java libraries and packages for handling multithreading, input/outputs and network communications. Finally, it initiates students to the use of documentation, and application monitoring (profiling, logs, and traces) tools.

020ELNES2/020DELES2 Digital Electronics 6 Cr.

Introduction to digital integrated circuit technology. Digital integrated circuits using MOS transistors, CMOS characteristics, fundamental building blocks, transistor level design of CMOS logic gates circuits, interfacing digital integrated circuits. Data converter basics: sampling, quantification, coding, analog switches, Overview of Analog to digital converter (ADC) and Digital to analog converter (DAC) circuits (Resistive Weights, R/2R, SAR, Flash). Introduction to Memory Devices: terminology, architecture, ROM, SRAM, DRAM, Memory assembly.
Prerequisite: Analog Electronics (020ELAES1/020AELES1).

020TNSES3/020DSPES3 Digital Signal Processing 4 Cr.

Digital signals and systems, sampling and reconstruction, quantization, SNR, truncation – Digital Filters FIR and IIR, time and frequency response, Z transform, filter stability – Structure of IIR and FIR filters – Discrete Fourier Transform DFT, Fast Fourier Transform FFT, Windowing and effects on spectrum – Analog filter design (Butterworth, Tchebychev, Bessel) – IIR filter design methods: Impulse invariance, bilinear transformation – FIR filter design methods: Windowing, frequency sampling – Real-time DSP card Implementation: Matlab and Simulink.
Prerequisite: Signal Theory (020THSES2/020STHES1).

020APDES4/020DAPES4 Distributed Applications 4 Cr.

This course raises students' awareness about the different software architecture patterns and enterprise applications patterns. This course also explains the need for using middleware in the context of object-oriented distributed applications (Java RMI, gRPC, reactive Java), as well as distribution on the web. It covers distributed Jakarta EE components (Stateless and

Stateful Session beans), as well as Message Driven Beans for asynchronous communication. It details Object Relational Mapping (ORM) and its implementation with JPA (Java persistence API) to manage persistence and access to relational and non-relational databases. As for distributed web applications, this course covers Servlets, as well as the implementation, testing and deployment of REST web services respecting level 3 of the Richardson maturity model, and respecting the HATEOAS principle, enabling students to compare them to SOAP web services. The course covers the documentation of REST Web APIs using the Open API Specification (Swagger). It introduces containers and explains their importance when deploying applications on-premises or on the cloud.

020EFPES4 Effective Programming 4 Cr.

Effective Programming is a course tailored for learning how to write optimized and high-performance code. To illustrate this concept, we chose an expert friendly language: C++. We first dive into the use of generic programming and templates to increase code efficiency. We then explore move semantics, an advanced C++ feature for performance optimization, especially in memory-intensive applications. We then extensively cover C++ Standard Library, a key player when it comes to efficient and optimized code. Recognizing that efficient code is part of a bigger system, the course introduces build engines, like CMake and Bazel. These are critical tools for managing dependencies and automating build processes in large software projects. They also enable the easy implementation of software performance tests. The final stretch of the course revolves around programming challenges. Here, the focus is on applying optimization techniques in real-world scenarios. Effective programming is designed with an emphasis on C++ techniques that lead to optimized, reliable, and high-performance software. It's a great pick for those planning a career in areas where high-performance computing is vital, such as game development, systems programming, embedded systems, and database applications.
Prerequisite: Object-Oriented Programming (020CPPES1/020OOPES1).

020IAEES5/020EAIES5 Enterprise Application Integration 4 Cr.

This course details the constraints and challenges of enterprise application integration, and shows the need to apply different Enterprise Integration patterns for each use case. It explains the difference between data, interface, or process integration. It explains the importance of business process automation. It describes centralized approaches with a hub-spoke architecture, using asynchronous messaging, according to the messenger pattern, as well as using an enterprise service bus. It details the microservice architecture and its deployment on the cloud through containerization/orchestration. It addresses the business complexity of microservices with Domain Driven Design and the CQRS pattern. It covers aspects related to implementing resilient cloud applications by embracing failure. Finally, it introduces the use of an event-driven architecture for the integration of data-intensive applications using Apache Kafka.

020SEMES3/020EMSES3 Embedded Systems 4 Cr.

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 – FGPA: 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 the hardware and the software – NIOS II processor creation and programming.
Prerequisite: Digital Systems Design (020TEDNI4/020DSDNI4 or 020TEDCI4), Programming 1 (020IF1NI2/020PR1NI2 or 020IF1CI2).

020ENTES1 Entrepreneurship 2 Cr.
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.

020PIRES5/020EHAES5 Ethical Hacking 4 Cr.
Introduction to Ethical Hacking – Footprinting and Reconnaissance – Scanning – Enumeration – Cracking Passwords – System Hacking and Post-attack – Network Hacking – Web Hacking – Social Engineering.

020PFEES6/020FYPES6 Final Year Project 16 Cr.
The final year project is carried out in groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval 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: Having validated 150 credits.

020PFSES3/020FPRES3 Functional Programming 4 Cr.
The objective of this course is to introduce the functional programming paradigm using, mainly, the Java programming language. It also illustrates some functional programming concepts in Python and introduces Scala as a multi-paradigm hybrid programming language. The course begins with an overview of functional programming followed by a gradual exposition of the evaluation model (used to reason about functional programs) alongside the explanation of the following concepts: recursion and the optimization of recursive functions, the use of functions as values, the partial application of functions, object immutability and its advantages, types and pattern matching, pairs and tuples, lists and functional collections, combinatorial search problem solving using for-expressions, lazy evaluation, functional streams, infinite sequences, the variance of polymorphism with regards to inheritance and a brief overview of key monad such as Option, Try and Future. These concepts will be illustrated by examples and exercises in Java, Python and Scala. Finally, the course will end with an introduction to program proving using structural induction.
Prerequisite: Object-Oriented Programming (020CPPES1/020OOPES1).

020GAIES5 Generative AI 4 Cr.

This course provides engineering students with an in-depth understanding of generative artificial intelligence, focusing on the design, implementation, and deployment of advanced generative models. Students will explore foundational architectures such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), autoregressive models, diffusion models, and transformer-based systems like GPT. The course also introduces Retrieval-Augmented Generation (RAG), a powerful paradigm that enhances large language models by integrating external knowledge sources for grounded and context-aware generation. In addition to mastering core modeling techniques, students will examine recent trends such as foundation models, multimodal generation, and the integration of generative models within agentic AI systems (autonomous, goal-driven agents capable of reasoning, planning, and tool use). Hands-on projects will allow students to apply these concepts to real-world tasks involving text, image, audio, and cross-modal generation. Ethical considerations, including bias, misinformation, and responsible deployment will also be discussed. By the end of the course, students will be prepared to build, fine-tune, and evaluate generative AI systems in both industrial and research contexts.
Prerequisite: Natural Language Processing (020NLPES3).

020TROES2/020GTOES2 Graph Theory and Operational Research 4 Cr.

This course introduces graph theory and operational research as engineering tools for modeling, optimization, and decision making. It covers the basics of graph theory; mathematical and numerical graph representation; connectivity; paths and cycles; graph search algorithms; algorithmic complexity; well-known problems in graph theory: minimum cost spanning tree, shortest path, and max-flow min-cut problems, matching, coloring, etc.; solving engineering and real-world problems using graphs; manipulating graphs using Networkx Python library; Markov chains and applications; complex network analysis; optimization and linear programming; numerical tools for solving optimization problems.

020ISSES5 Information Security - Standards and Best Practices 4 Cr.

An introductory session on key concepts and risk analysis is delivered before discussing the various IT security standards, best practices, standards and guidelines. It will discuss the ISO 27001-2 2022 standard, PCI DSS 4.0, OWASP, SANS-CIS V8 top 18 cyber security controls. This course also covers the following areas: Security policy and procedures, human resources security, physical and logical security of systems and networks, incident management and business continuity management.

020ATIES5/020AITES5 Information Technology (IT) at Work 4 Cr.

This course introduces and explains the foundations of IT going through the main building blocks that are common and vital for any organization to work. The objective of this course is to focus on the practical aspect of IT in a company whether it has its own IT system, on the cloud, or hybrid. The scope covers Datacenter, Servers, Storage, Network & Security, Information Systems design and Build, Information Systems Operations, Application Landscape, Integration Layer, Procurement & Budget and building an internal Cloud. It includes an overview, best practices and pitfall, and a series of practical use cases that illustrate real life scenarios.

020TICES5/020ITCES5 Information Theory and Coding 4 Cr.
This course introduces the limits of possible in digital communications systems and the techniques that can be used to approach these limits. The course covers the basics of information theory like the information associated to an event, entropy, mutual information, data processing theorem, source coding, Huffman codes, channel capacity and the channel coding theorem. The course also covers the channel coding techniques used to improve the performance of a communications system like block codes, the algebraic structure of cyclic codes, BCH codes, Reed Solomon codes, convolutional codes, LDPC codes, Turbo codes and Polar codes.
Prerequisite: Analog and Digital Communications (020CONES3/020ADCES2).

020INDES2 Innovation and Design Thinking 2 Cr.
The aim of this course is to learn about the creative mindset and particular practices that enable innovation. Throughout this course, students are brought to explore creativity and the sources of innovative ideas. Because believing that one can be creative is the first step to becoming an innovative thinker and leader, the course discusses the strategies for enhancing creative confidence and instilling it in others. It also introduces the design thinking process, which is a time-tested approach for practicing innovation. Students will also explore the various aspects of the design thinking process, from need finding and empathy to generating insights to prototyping and experimenting. Finally, the course deals with how to create and implement an innovative mindset in a work environment and how to influence and inspire others.

020EEIES4/020IEEES4 Internet Ecosystem and Evolution 4 Cr.
Internet governance – Autonomous system interconnection – Transit and peering agreements – Internet exchange points – Concepts of external routing – BGP routing protocol – BGP routing policies – Security of routing in the Internet – Utility and demand models – Pricing models in the Internet.
Prerequisite: Introduction to Data Networks (020INRES1/020IDNES1).

020IDOES5/020ITTES5 Internet of Things Technologies 4 Cr.
IoT reference model – End-to-end IoT chain – Constraints and challenges of connected devices – Hardware architecture of connected devices – Wireless LAN (IEEE 802.11, IEEE 802.15.4, BLE, ZigBee) – Low power long range networks (LoRa, Sigfox, NB-IoT) – Routing protocols (AODV, OLSR, RPL, LOADng) – IPv6 for IoT – Application layer (MQTT, XMPP, COAP) – Operating systems for connected devices – hands-on and deployment of end-to-end IoT chain.
Prerequisite: Introduction to Data Networks (020INRES1/020IDNES1).

020INRES1/020IDNES1 Introduction to Data Networks 6 Cr.
This course introduces the basic principles and the various techniques governing the operation of data networks and the Internet, with particular focus on the TCP / IP stack protocols. It covers the architecture of data networks and the Internet; Circuit and packet switching; Protocols and standardization bodies; OSI and TCP / IP layers; Access mechanisms

and Ethernet/Wifi technologies in local area networks; The switched architecture of local area networks; IP (IPv4 and IPv6); Routing; Designing IP addressing; Transport protocols (TCP and UDP) and their reliability mechanisms, WEB, mail, DNS and DHCP services; Socket programming, the basic concepts of security. On a more practical level, this course offers a set of practical exercises that introduces students to the implementation of a network and configuration of the switching equipment; The use of network simulation tools and protocol analysis; Socket programming. This is a blended course offering the Semester 1 of Cisco CCNA Routing & Switching online material.

020ISDES3/020IDSES3 Introduction to Data Science 4 Cr.
Introduction to Data Science: introduction: data scientists work steps – numpy, pandas – data acquisition, data wrangling: data formats - pandasql, SQLite - Api, data checking, data preparation, partial deletion, imputation – exploratory data analysis: statistical significance tests, statistical rigor, t-tests, normal distribution, welch's t-test, non-normal data, Shapiro-wilk test, Mann-whitney u test, non-parametric tests, machine learning, linear regression, gradient descent, coefficient of determination – data visualization: information visualization, components of effective visualization: visual cues, coordinate systems, scale and data types, context – visualization time series data, plotting in python – big data: basics of MapReduce: Hadoop – implementation: Jupyter Notebook.

020MLRES4 Machine Learning 4 Cr.
This course introduces students to the fundamental principles and practical techniques of machine learning with an overview of supervised, unsupervised, and generative learning paradigms. It begins by emphasizing hands-on experience by delving into Exploratory Data Analysis (EDA). It then develops and evaluates traditional supervised learning models for classification and regression. The course then covers the theoretical foundations of deep learning and the implementation/evaluation of Multilayer Perceptrons (MLPs) solutions for both classification and regression tasks. Learners will also explore clustering techniques, dimensionality reduction, and applications such as CNNs for Computer Vision (CV) and RNNs, LSTMs, and GRUs for Natural Language Processing (NLP). Students will engage with modern NLP tools including Hugging Face Transformers and explore pretrained models and annotation tools in CV. The course concludes with an introduction to Generative AI, including GANs, Diffusion Models, Attention Mechanisms, and Transformer architectures. All solutions are implemented in Python using industry-standard libraries such as Scikit-learn, TensorFlow, and Keras. Ethical and societal considerations (including fairness, bias, transparency, explainability, and privacy) are discussed to highlight the broader impact of machine learning technologies.
Prerequisite: Statistics (020STAES1/020STTES1).

020MLOES5 Machine Learning Operations 4 Cr.
This course offers a comprehensive exploration of software engineering principles specifically adapted for artificial intelligence (AI) applications. It covers the full software development lifecycle (SDLC) of AI systems, including requirements engineering, design patterns for machine learning workflows, and software architecture for intelligent systems. Emphasis is placed on modern machine learning operations (MLOps) practices, such as automated

training and deployment pipelines, model monitoring and performance evaluation, model versioning, and lifecycle management. The course also addresses responsible AI development, focusing on fairness, bias mitigation, and explainability, equipping students with the tools and methodologies needed to build robust, scalable, and ethical AI-powered software solutions.
Prerequisite: Machine learning (020MLRES4).

020MNGES5 Management 2 Cr.
This course is a study of management theories, emphasizing the management functions of planning, decision-making, organizing, leading and controlling.

020SMPES3/020MPSES3 Microprocessor Systems 4 Cr.
Difference between microprocessors, microcontrollers and DSP – microprocessor architecture; realization of a basic board – Microcontroller architecture (PIC 18F2520) – Implementation of ROM, RAM and DATA EEPROM memory – special registers – addressing modes – inputs/outputs – interrupts – timers – analog to digital converter – asynchronous serial port – read from program memory – comparators – watchdog – sleep mode – Low Voltage Detect – oscillator – configuration words – Design, simulation and realization of microprocessor systems.
Prerequisite: Digital Systems Design (020TEDNI4/020DSDNI4 or 020TEDCI4).

020PCHES3/020MLCES3 Microwave Links and Circuits 4 Cr.
Free space propagation loss – Effects of atmospheric phenomena – Diffraction and diffusion – RF analog and digital links – microwave junctions – microwave filters used microstrip technology – Microwave sources – S-matrix of quadripole (attenuators, phase shifters), hexapole (T in planes H and E, Y), octopole – 3dB, 30dB coupler, Magic Tee) – anisotropic junctions (insulator, circulator) – Transistors (bipolar and FET) – Diodes (Tunnel, Gunn, IMPATT) – Sources (Triode, pentode, TOP, klystron and magnetron).
Prerequisite: Electromagnetism (020EMENI3/020ECMNI3 or 020EMECI3).

020MMDES4 Mining Massive Datasets 4 Cr.
Introduction to Massive Data Challenges, High Performance File System and MapReduce, Link Analysis in Graphs, Similar Sets, Similar Item Sets, Community Detection in Graphs, Mining Data Streams, Recommender Systems, Clustering and Classifiers.

020CCIES4/020ICDES4 Mixed-Signal IC Design 4 Cr.
In this applied course, students are introduced to the use of an industrial EDA Software tool to acquire computer-aided design skills in the field of Integrated Circuit Design. The course contents are as follows: IC Design Flow, Fabrication Technology and Packaging, Multi-stage Amplifiers, Current Mirrors and Active Loads, Basic Biasing concepts, Differential signaling, Operational Amplifier Transistor-Level Design, Filters, Sampled circuits, Buffers, Frequency response of analog feedback circuits, Introduction to stability of feedback amplifiers, Simulation and Evaluation of the electrical performance of ICs using EDA Software, Introduction to Noise and Linearity in Electronics.
Prerequisite: Digital Electronics (020ELNES2/020DELES2).

020DMOES4/020MADES4 Mobile Applications Development 4 Cr.

The Mobile Application Development course is designed to provide students with a comprehensive understanding of developing applications for mobile platforms. In today's digital landscape, mobile applications play a vital role in connecting businesses and users, making this course highly relevant and in-demand. During this course, students learn the essential concepts, tools, and techniques required to develop mobile applications for popular platforms such as Android and iOS. Through hands-on projects and real-world examples, students gain practical experience in designing, developing, and deploying mobile applications. By the end of the course, students will have the knowledge and skills to independently develop and deploy mobile applications for various platforms. They will have a strong foundation in mobile app development, enabling them to pursue careers as mobile app developers or entrepreneurs in the app industry.

020REMES4/020MONES4 Mobile Networks 4 Cr.

This course covers the evolution of mobile networks; link-level and system-level design aspects of 2G, 3G, 4G, and 5G networks: services, architectures, radio interface, radio resource management, call flow management, data flow management, mobility management, and security management; GSM evolution to GPRS and EDGE; UMTS evolution to HSPA and HSPA+; LTE evolution to LTE-Advanced and LTE-Advanced Pro; 5G network virtualization; recent advances in mobile networks.
Prerequisite: Wireless Communications (020CSFES3/020WICES3).

020PRMES4/020MDPES4 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.

020NLPES3 Natural Language Processing 4 Cr.

This Natural Language Processing (NLP) course offers a foundational and practical understanding of key NLP techniques, from text processing and feature extraction to modern machine learning and deep learning approaches. Students will explore core methods like tokenization, sentiment analysis, and topic modeling, using tools such as NLTK and spaCy. The course delves into advanced models, including RNNs, LSTMs, and Transformers like BERT and GPT, highlighting their real-world applications. Through hands-on projects, students will learn to build and evaluate NLP models, understand ethical considerations, and apply NLP techniques across various industries, preparing them for advanced work in AI-driven language processing.

020IDRES5/020NENES5 Network Engineering 4 Cr.
This course covers the fundamental principles of network engineering; radio network planning; deployment considerations for mobile networks; quality of service and mobile network optimization; optical network protection and survivability; WDM network design; network virtualization; artificial intelligence in networking.

020RCOES2/020NRSES2 Network Routing and Switching 4 Cr.
Concepts of network switching – Hardware architecture of routers and switches – Virtual Local Area Networks (VLANs) – Inter-VLAN routing and switching – Redundancy in networks – Spanning Tree Protocol (STP) – Routing Concepts – Static Routing – Static vs. dynamic routing – Dynamic routing – RIP protocol – EIGRP protocol – OSPF protocol – Semester 2 of CCNA Routing & Switching certification program (CCNA2).
Prerequisite: Introduction to Data Networks (020INRES1/020IDNES1).

020NQLES3 NoSQL Databases 4 Cr.
This course explores the technology of NoSQL databases, used in contexts where relational databases have limitations, notably in the field of Big Data, advanced analytics, and storage of data with different structures. The course begins with a review of the principles of relational databases and their limitations, then examines in detail the various types of NoSQL databases and their specific applications. The covered technologies include column databases, document databases, key-value databases, graph databases, and distributed computing. Practical work is planned for most of the databases studied.
Prerequisite: Relational Databases (020BDRES2/020RDBES2).

020MENES1/020NUMES1 Numerical Methods 4 Cr.
Introduction to numerical calculation, error analysis and propagation, numerical software, interpolation and approximation, integration and differentiation, numerical solution to differential equations, finite difference method, matrices, resolution of linear systems, matrix decomposition, eigenvalues and eigenvectors, non-linear system of equations.
Prerequisite: Differential Calculus (020CDFNI4/020DFCNI4) or Analysis 2 (020AN2CI3), Linear Algebra (020LALNI2/020LALNI2) or Algebra 1 (020AL1CI2).

020CPPES1/020OOPES1 Object-Oriented Programming 6 Cr.
This course introduces the fundamentals of programming in C and C++ with a focus on both procedural and object-oriented paradigms. Students will begin with C/C++ syntax, including typed variable declarations, basic input/output operations, expressions, and type conversions. Core control structures such as conditional branching, for and while loops, as well as function definitions, prototypes, parameter passing, and function overloading will be covered. The course then explores arrays, strings, pointer arithmetic, manual memory management, and cyclic dependency resolution, including deep copies and smart pointers. Students will gain a solid foundation in object-oriented programming, learning key concepts such as abstraction, encapsulation, inheritance, and polymorphism. Practical implementation includes defining classes, constructors, destructors, methods, attributes, static members, access modifiers, and operator overloading. The course also introduces modern software

development practices using VS Code, compiling with CMake, and version control with Git and GitHub.
Prerequisite: Programming 2 (020IF2NI3/020PR2NI3 or 020IF2CI3).

020SSEES4/020OPSES4 Operating Systems **4 Cr.**
Introduction to operating systems – Operating system structures, computer hardware properties – Process concept in modern operating systems – Multi-processes – Thread concept and multi-threading – Process synchronization – Deadlocks in multi-processing – Memory management – Virtual memory management – CPU scheduling algorithms – File system – Disk subsystem – Security.

020ROPES5/020ONIES5 Operator Networks Infrastructure **4 Cr.**
Overview on operator networks architecture – Study of the operator networks architecture in Lebanon: access network, aggregation network, and backbone network – xDSL physical layer – xDSL devices (DSLAM, BRAS) – xDSL network layer (ATM transport, authentication) – Telephone access architecture – Evolutions in the public operator network in Lebanon – Concepts of virtual circuit switching – Evolution towards MPLS architecture – MPLS VPN services – Deployment of ADSL network platforms – Deployment of MPLS network platforms.
Prerequisite: Introduction to Data Networks (020INRES1/020IDNES1).

020SYOES4/020OSNES4 Optical Systems and Networks **4 Cr.**
This course covers the fundamentals of optical communications (with emphasis on signal degradation mechanisms in optical fibers); passive and active optical components; optoelectronic transmitters; optoelectronic receivers; WDM concepts and technologies; optical amplifiers; design of optical transmission systems; optical networks: access networks, optical transport networks, and wavelength routing networks.
Prerequisite: Electromagnetism (020EMENI3/020ECMNI3 or 020EMECI3).

020OAIES5 Optimization for AI **4 Cr.**
This course aims to provide students with a solid theoretical and practical foundation in mathematical optimization techniques essential to the development and refinement of machine learning algorithms and artificial intelligence applications. Students will learn to analyze and implement optimization methods, including gradient-based algorithms, adaptive learning rate techniques (e.g., Adam, RMSProp), automatic differentiation, and backpropagation, while addressing critical training challenges such as vanishing and exploding gradients. The course also covers neural network initialization strategies, dimensionality reduction (PCA), density estimation, and support vector machines (SVM), along with both unconstrained and constrained optimization problems. By the end of the course, students will be equipped to apply these techniques to improve model performance and solve complex problems across various AI domains.
Prerequisite: Statistics (020STAES1/020STTES1).

020PPLES5/020PPRES5 Parallel Programming **4 Cr.**
Parallel architectures – Parallel Computing – Concurrency and Threads – Parallelism in C++ 17 & OpenMP – Message Passing Interface (MPI) – Heterogenous Programming and GPUs.

Prerequisite: Object-Oriented Programming (020CPPES1/020OOPES1).

020PSRES4/020PCSES4 Performance of Computer Systems and Networks 4 Cr.
This course proposes the use of mathematical tools such as stochastic processes and optimization for modeling, performance analysis, and dimensioning of computer systems and networks. It introduces the Poisson processes; the processes of birth and death; Basic M/M queues; Discrete and continuous Markov processes; Queuing networks; Priority queueing and scheduling strategies; Traffic patterns in networks; Performance evaluation by simulation. This course focuses on the application of these tools on real problems and the use of digital tools to solve these problems.
Prerequisite: Probability (020PRBNI4/020PRONI3) or Analysis 3 (020AN3CI4).

020PCBES5 Printed Circuit Board Design Fundamentals 4 Cr.
This course introduces the fundamentals of designing Printed Circuit Boards (PCBs) using industrial EDA software tool. Students will learn the key concepts, tools, and techniques used in PCB design, including schematic capture, component placement, routing, design rules, and manufacturing considerations. The course also covers topics such as signal integrity, parasitic, coupling, controlled impedance and power distribution. The course also includes a project realization of a complex circuit using Proteus software.
Prerequisite: Digital Electronics (020ELNES2/020DELES2).

020GPRES2/020PMGES1 Project Management 4 Cr.
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 objective 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.

020QOSES5/020QSNES5 Quality of Service in Networks 4 Cr.
Traffic control in networks – Congestion control – Traffic shaping – Traffic policing – Traffic engineering – Quality of experience – Performance metrics in networks: delay, jitter, and loss probability – IP traffic models and properties – Architectures for quality of service – DiffServ model – Multimedia transport – IP multicast – Quality of service deployment in local networks – Quality of service deployment in wireless local networks – Quality of service deployment in the Internet – Internet regulation – Network neutrality – Passive and active measurements in networks – Collaborative measurement of quality of service.
Prerequisite: Introduction to Data Networks (020INRES1/020IDNES1).

020BDRES2/020RDBES2 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.

020RESES5/020SENES5 Secured Enterprise Networks 4 Cr.
Understanding security services used when designing a secure enterprise network. Packet and content filtering, Security zones, Intrusion prevention techniques, Public Key Infrastructures, Virtual Private Networks, Network Access control, Data Leak Prevention, Network Management, Security Events and Information Management, SOC tools, SDN security, Design principles of a secure network. Case studies on designing an enhanced secure network design, dimensioning principles of security controls and appliances.
Prerequisite: Network Routing and Switching (020RCOES2/020NRSES2).

020THSES2/020STHES1 Signal Theory 4 Cr.
This course introduces the basic concepts for analyze and treatment of continuous and discrete-time deterministic signals, as well as continuous and discrete-time random processes. The course covers Fourier transform, Parseval theorem, distributions, Fourier series decomposition for periodic signals, linear time-invariant systems, linear filtering of continuous signals, linear and non-linear distortions, sampling, Z-transform, discrete-time Fourier transform, continuous and discrete random signals, 2nd-order stationarity of continuous and discrete-time random processes, representation of narrow band signals.
Prerequisite: Analysis 2 (020AN2NI4/020AY2NI3) or Analysis 3 (020AN3CI4), Probability (020PRBNI4/020PRONI3) or Algebra 3 (020AL3CI4).

020GLOES5/020SOEES5 Software Engineering 4 Cr.
This course describes the problems related to programming in the Large vs programming in the Small, at the level of cost, quality, functionalities and time management. It explains the methodologies related to the project development life cycle according to sturdy traditional approaches, such as CMM, TSP, PSP, RUP as well as according to agile methodologies such as, XP and Scrum (concepts, roles and ceremonies) as well as the waterfall and iterative lifecycles. It details elicitation techniques and software requirement specification writing rules and templates. It also describes many specification tools used for the analysis of functional and non-functional requirements. It explains the DRY, KISS and SOLID principles mainly its advanced object-oriented design concepts (OCP, LSP, etc.), and covers all the UML diagrams for OO modeling. It also explains the CRC Card design method adopted by the eXtreme Programming methodology. It demonstrates the need for continuous refactoring and explains refactoring techniques at a surgical, tactical and strategic level. It also describes the process to follow in order to succeed in refactoring, starting by configuring and using configuration/source code management tools like Git/GitHub, as well as testing and bug management software, then, by evaluating the quantitative and qualitative code quality in order to find eligible refactoring candidates and finally by executing and validating the refactoring step. This course describes the testing pyramid and details unit/integration/functional and non-functional testing, while stressing on the need for Test Driven development using JUnit. It compares methods that can be used to estimate the cost of a software. It explains UI/UX to-do and not-do basics by studying the different cases of

standalone, and web applications focusing on accessibility issues. Finally, it introduces DevOps principles and raises students' awareness about SAAS development and the value of IT automation.

020SQAES4 Software Quality Assurance 4 Cr.

This course, Software Quality Assurance, offers an in-depth exploration into the methodologies, techniques, and tools used in the quality assurance and testing of software systems. It is designed to equip students with the knowledge and practical skills necessary to ensure the quality and reliability of software products. Throughout the course, students will delve into the key concepts of software quality assurance, learn various testing methods, and understand the role of a QA engineer in the software development lifecycle. The curriculum includes both theoretical foundations and hands-on practice, enabling students to apply learned concepts in real-world scenarios.

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

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 the 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 software, STK tracker software, design and implement (tabletop) a nanosatellite type Cubesat 1U using commercial components and boards.
Prerequisite: Analog Electronic (020ELAES1/020AELES1), Mechanics 1 (020MC1NI1/020MH1NI1 or 020MC1CI1).

020STAES1/020STTES1 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 (020PRBNI4/020PRONI3) or Algebra 3 (020AL3CI4).

020ADUES3/020USAES2 Unix System Administration 4 Cr.

This course provides a comprehensive introduction to Unix and Linux operating systems, emphasizing practical skills and foundational concepts. Students will explore the Linux command-line interface, essential file system navigation, and disk management techniques.

Key topics include text editing with tools like vi and nano, writing basic shell scripts for task automation, and performing core system administration tasks. The course also covers process and system monitoring, as well as essential networking and security principles. By the end, students will be equipped with the skills needed to confidently operate and manage Unix/Linux environments in both academic and professional settings.

020VRTES4 Virtualization 4 Cr.
Introduction to virtualization and its fundamentals, advantages and disadvantages of virtualization, use cases, hypervisor role and components, types of virtualization (full virtualization, paravirtualization, hardware-assisted virtualization, partitioning), review of existing solutions such as Xen, ESXi, KVM, OpenVz, etc., network virtualization (NFV and SDN), storage and SAN virtualization, virtualization and containers, virtualization and the cloud: OpenStack.

020PGAES3/020WGAES3 Waveguides and Antennas 4 Cr.
Transmission line theory – Lines in sinusoidal and transient regimes – Smith chart – TOS and stub adaptation – Waveguides (parallel plate, rectangular, cylindrical and dielectric) – General solutions for TEM, TE and TM waves – Fundamental parameters of antennas, gain and power directivity – Dipole antenna and linear wire antennas – Array antennas – Horn and reflector antennas (terrestrial antenna) – Smart antennas – Adaptive and switched-beam antennas.
Prerequisite: Electromagnetism (020EMENI3/020ECMNI3 or 020EMECI3).

020PWBES3/020WBPES3 Web Programming 4 Cr.
This course covers the development of web applications on both the frontend (client-side) and the backend (server-side). It is, in fact, a hands-on web programming course where a MongoDB, Express, React and Node (MERN) web application is gradually designed and implemented as the course progresses.
The course first introduces the basic languages used for web development, namely HTML, CSS and JavaScript. They are followed by the introduction of the Twitter Bootstrap web framework and the quick implementation of several web pages using this framework. Afterwards, the React framework along with its underlying Flux architecture is explained. A React Single Page Application (SPA) is then implemented. At this stage, the frontend has been fully implemented while the backend is still mocked using a simulated JSON-Server. This mock backend is then replaced by a fully functional REST API implemented using Node.js, the Express framework and the MongoDB database. This REST API is then tested using Postman before it is integrated with the react frontend, concluding the implementation of a full stack MERN web application.
Each part of this full stack MERN application can now be deployed on a cloud provider such as Heroku to provide Software as a Service (SaaS) functionalities. We then introduction Google Firebase which provides Backend as a Service (BaaS) functionalities to discharge the developer from implementing a backend. We then conclude with an initiation to Angular as a possible alternative to React for building enterprise full stack MongoDB, Express, Angular and Node (MEAN) web applications.

020ADWES4/020WSAES4 Windows System Administration 4 Cr.
This course introduces the basic concepts involved in installing, configuring and administering Microsoft Windows Server 2016. The course defines some of the terms involved in systems administration, such as peer-to-peer, client/server, workgroup, and domain. The course also lists the major Operating System releases from Microsoft and lays out the differences between a client and a server operating system. It focuses on the hardware requirements needed to install Microsoft Windows Server 2016 and then goes through the installation process. It then explains DHCP and DNS operation and how to install and configure a DHCP and a DNS Server. Finally, the course presents an introduction to Active Directory and explains how to enable this role on one or more servers in the network. Some of the basic tasks performed by the network administrator are presented, such as creating user and group accounts, assigning file and folder permissions and setting basic security policies.

020CSFES3/020WICES3 Wireless Communications 4 Cr.
This course covers the fundamentals of wireless communications (with emphasis on wireless channel modeling); digital modulation in wireless channels; channel coding and interleaving in fading channels; equalization; diversity; multiple antenna systems; spread spectrum; multicarrier modulation; multiple access; WiFi networks.

020WRNES1 Work Ready Now 2 Cr.
Personal development - Communication skills - Job seeking skills - Work behaviors.

BACHELOR OF ENGINEERING IN ELECTRICAL ENGINEERING

Main Language of Instruction:

French: ◙	English □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The Bachelor of Engineering in Electrical Engineering aims to graduate students able 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)

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

Program Requirements

180 credits: Required courses (154 credits), Institution’s elective courses (22 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits - part of the above categories).

Fundamental Courses

Required Courses (154 Cr.)

Accounting (4 Cr.)

Analog Electronics (6 Cr.)
Business Ethics (4 Cr.)
Business Law (2 Cr.)
Communication Skills (2 Cr.)
DC-AC Conversion (4 Cr.)
DC-DC Conversion (4 Cr.)
Digital Electronics (6 Cr.)
Digital Systems and Control (4 Cr.)
Dynamic Systems Modeling (4 Cr.)
Electric Machines 1 (6 Cr.)
Electric Machines 2 (4 Cr.)
Electrification 1 (6 Cr.)
Electrification 2 (4 Cr.)
Electrotechnics (6 Cr.)
English (4 Cr.)
Industrial Electronics (6 Cr.)
Innovation and Design Thinking (2 Cr.)
Linear Control (6 Cr.)
Management (2 Cr.)
Microprocessor Systems (4 Cr.)
Modern Control (4 Cr.)
Object-Oriented Programming (6 Cr.)
Power Systems Analysis (4 Cr.)
Project Management (4 Cr.)
Renewable Energy (4 Cr.)
Sensors and Instrumentation (4 Cr.)
Signals and Systems (4 Cr.)
Statistics (4 Cr.)
Variable-Speed Drive Systems (6 Cr.)

Corporate Internships (2 Cr.) – During their studies, each student can complete two internships:

- A recommended labor internship of at least 4 weeks at the end of the third year of studies.
- A required technical internship of 6 to 10 weeks at the end of the fourth year of studies (2 Cr.).

Multidisciplinary Project (6 Cr.)

This project brings together students from different programs and/or options 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

Final Year Project (16 Cr.)

The final year project is carried out by groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and two oral presentations are the main deliverables of the project.

Institution's Elective Courses (22 Cr.)

Advanced Microcontroller Systems (4 Cr.)
Artificial Intelligence (4 Cr.)
Design of Mechatronics Systems (4 Cr.)
Embedded Systems (4 Cr.)
Entrepreneurship (2 Cr.)
Fluid Mechanics (4 Cr.)
Fuzzy Logic and Neural Networks (4 Cr.)
Home Automation (4 Cr.)
HVAC 1 (4 Cr.)
HVAC 2 (4 Cr.)
Industrial Engineering (4 Cr.)
Industrial Process and Control (4 Cr.)
Mixed-Signal IC Design (4 Cr.)
Machine Learning (4 Cr.)
Nonlinear Systems (4 Cr.)
Numerical Methods (4 Cr.)
Optimization (4 Cr.)
PCB Design Fundamentals (4 Cr.)
Power Generation (4 Cr.)
Profitability of Energy Projects (4 Cr.)
Robotics (4 Cr.)
Space and Micro/Nano Satellite Technologies (4 Cr.)
System Identification (4 Cr.)
Wheeled Robots (4 Cr.)
Work Ready Now (2 Cr.).

Open Elective Courses (4 Cr.)

Arabic Culture and Language (2 Cr.)
One Open Elective Course (2 Cr.)

USJ General Education Program (26 Cr. out of 36 Cr.)

10 additional credits are earned at 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 Courses 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 Courses	***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

Semester 1

Code	Course Name	Credits
020ELAES1	Analog Electronics	6
020MSDES1	Dynamic Systems Modeling	4
020ETCES1	Electrotechnics	6
020CPPES1	Object-Oriented Programming	6
020SYSES2	Signals and Systems	4
020STAES1	Statistics	4
	Institution’s Elective course: Work Ready Now or Entrepreneurship	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020TCOES2	Communication Skills	2

020ELNES2	Digital Electronics	6
020ME1ES2	Electric Machines 1	6
020IE1ES2	Electrification 1	6
020ELIES2	Industrial Electronics	6
020AULES2	Linear Control	6
	Open Elective: Arabic Language and Culture	2
	Total	**34**

Semester 3

Code	**Course Name**	**Credits**
020CCCES3	DC-DC Conversion	4
020SCNES3	Digital Systems and Control	4
020ME2ES4	Electric Machines 2	4
020IE2ES3	Electrification 2	4
020INDES2	Innovation and Design Thinking	2
020SMPES3	Microprocessor Systems	4
020GPRES2	Project Management	4
020CEIES3	Sensors and Instrumentation	4
	Institution’s Elective course	4
	Total	**34**

Semester 4

Code	**Course Name**	**Credits**
020CCAES4	DC-AC Conversion	4
020ANGES4	English	4
020CTMES4	Modern Control	4
020PRMES4	Multidisciplinary Project	6
020EVVES4	Variable-Speed Drive Systems	6
	Institution’s Elective course	8
	Open Elective	2
	Total	**34**

Semester 5

Code	**Course Name**	**Credits**
020CMPES5	Accounting	4
020ETHES3	Business Ethics	4
020DROES5	Business Law	2
020STGES5	Corporate Internship	2
020MNGES4	Management	2
020ANRES4	Power Systems Analysis	4
020ERNES6	Renewable Energy	4
	Institution’s Elective course	8

	Total	**30**

Semester 6

Code	Course Name	Credits
020PFEES6	Final Year Project	16
	Total	**16**

Course Description

020CMPES5 Accounting **4 Cr.**

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.

020SAMES4 Advanced Microcontroller Systems **4 Cr.**

Introduction to embedded systems – Introduction to STM32 family of MCUs and STM32CubeIDE –Principles of schematic interpretation for embedded applications – Overview and practical exploration of MCU Peripherals: ADC, DAC, Advanced Timers, PWM, UART, I2C, SPI, DMA, SDIO, USB – Introduction to Real Time Operating System (RTOS) – Introduction to machine learning on MCUs and TinyML.
Prerequisite: Microprocessor Systems (020SMPES3)

020ELAES1 Analog Electronics **6 Cr.**

This course covers the main low-power electronic components: 1) P-type and N-type semiconductors – P-N junction; 2) diodes: characteristics and application circuits (clipping, rectification…), Zener diode (regulation), Light-emitting diode. 3) Bipolar transistor: DC operation (I-V characteristics, Biasing, Load line), AC operation (amplifier circuits), synthesis of amplifier circuits, Bipolar transistor as switches. 4) MOSFET transistors: I-V characteristics, resistive operation and amplification. 5) Operational amplifier (OA): behavioral model and imperfections, application circuits (Inverting/Non-inverting amplifiers, Integrators, Voltage Follower, Active filters). 6) Comparator: characteristics, performance & limitations, applications.
Prerequisite: Linear Electrical Systems and Networks (020SRLNI4 or 020SRLCI4)

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.

020IA2ES4 Artificial Intelligence 4 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). It then introduces Machine Learning (ML) algorithms with some applications.

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 destined to work in public or private companies and in all fields. Its objective is to create awareness for the need of 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 it.

020DROES5 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.

020TCOES2 Communication Skills 2 Cr.
Communication is of high importance for an engineering student. Indeed, whether in academic or professional activities, transmitting information is a powerful tool for convincing

and even influencing others. Communication is unavoidable, but it comes with many errors and risks that should be avoided. Otherwise, the reception of the information may be disturbed and misunderstood. This course offers students the knowledge of essential basic rules of main ways of communication (written, verbal and non-verbal) and makes them aware of the errors to be avoided.

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.

020CCAES4 DC-AC Conversion 4 Cr.
In this course, different topologies of DC-AC switch-mode power converters are presented: single and three-phase inverters, two and multilevel structures. A detailed analysis starting from the possible configurations, then the establishment of the mathematical equations, the waveforms and the input-output features, and the selection of the semiconductor devices and all other components is elaborated for each topology. Rating criteria based on the evaluation of the voltage and current stresses are elaborated.
In addition, different Pulse-Width-Modulation (PWM) control strategies are introduced and studied: carrier-based PWM, space-vector modulation, pre-calculated modulation, sigma-delta and delta modulations. Numerical simulations are performed to verify the theoretical concepts.
Prerequisite: DC-DC Conversion (020CCCES3)

020CCCES3 DC-DC Conversion 4 Cr.
In this course, different topologies of DC-DC switch-mode power converters are presented. Two categories of converters are studied: choppers for DC-motor drives and DC power supplies. A detailed analysis starting from the possible configurations, then the establishment of the mathematical equations, the waveforms and the input-output features, and the selection of the semiconductor devices and all other components is elaborated for each topology. Rating criteria based on the evaluation of the voltage and current stresses are elaborated.
Prerequisite: Industrial Electronics (020ELIES2)

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).

020ELNES2 Digital Electronics 6 Cr.
Topics covered include: Introduction to digital integrated circuit technology. Digital integrated circuits using MOS transistors, CMOS characteristics, fundamental building blocks, transistor level design of CMOS logic gates circuits, interfacing digital integrated circuits. Data converters basics: sampling, quantification, coding, analog switches, Overview of Analog to digital converter (ADC) and Digital to analog converter (DAC) circuits (Resistive Weights, R/2R, SAR, Flash). Introduction to Memory Devices: terminology, architecture, ROM, SRAM, DRAM, Memory assembly.
Prerequisite: Analog Electronics (020ELAES1)

020SCNES3 Digital Systems and Control 4 Cr.
This course is divided into three main parts. The first part discusses discrete system modeling, Z-transform, discrete transfer functions and discrete systems stability. The second part develops the design of digital controllers (discretized classic controllers, dead-beat control). The final part presents the implementation of digital controllers using embedded systems and real time simulations of a system in closed loop.
Prerequisites: Linear control (020AULES2), Signals and systems (020SYSES2)

020MSDES1 Dynamic Systems Modeling 4 Cr.
The aim of this course is to introduce and train students to the crucial importance of modeling and analysis in the industry nowadays that leads to performance improvement, better time management and manufacturing cost reduction of a given product. These goals are taught through examples of electrical, mechanical, thermal, and complex systems. Pre-sizing, modeling, analysis of operation and performance are performed through simulations using the advanced software MATLAB/Simulink. This course initiates engineering design to students through iterative improvements, feasibility study and process optimization before the usual industrial prototyping.
Prerequisite: MATLAB (020MATNI4)

020ME1ES2 Electric Machines 1 6 Cr.
Topics covered include: Construction and operation of rotating machines in steady state. Electromechanical conversion, rotating magnetic field, dc machines, induction machines and synchronous machines operating as either a generator or a motor. Equivalent circuits, tests, and determination of the parameters of the equivalent circuits. Use an equivalent circuit to predict the performance of a machine with reasonable accuracy. Electromagnetic torque and shaft torque. Torque-speed characteristics, efficiency, nameplate, and rated values. Introduction to variable speed drives.
Prerequisite: Electrotechnics (020ETCES1)

020ME2ES4 Electric Machines 2 4 Cr.
This course aims to extend the concepts of electrical engineering according to four axes: I) Transformers: Special transformers – Transformers in unbalanced mode – Transformers in

transient mode – Parallel operation of transformers. II) DC machines: DC machines in transient mode - Application in unsaturated transient conditions. III) Induction Machines (IM): Generator and brake operation of a three-phase IM - Special types of IM: Deep-Bar Squirrel-Cage, Double-Cage rotors and Single-Phase IM – Modeling of the induction machine in transient mode and applications. IV) Synchronous machines: Rotating fields theory – Transient modeling of synchronous machines: with smooth poles, with salient poles, with or without damper bars – Applications.
Prerequisite: Electric machines 1 (020ME1ES2)

020IE1ES2 Electrification 1 6 Cr.
Topics covered include: Earthing System, low voltage electrical equipment, Overview of IEC 60364 and NFC-150 standards, low-voltage electrical equipment, control and protection equipment, electrical schemes, surge arresters. Photometry and lighting, photometric terms, luminous efficiency, different types of lamps, lighting of the premises, lighting standards, the different types of lighting, photometric class, photometric curve & Kruithof's rule. Lighting project: Lighting of closed areas, type of luminaire, calculation, UGR. Public lighting and projectors, functional lighting, residential lighting, projectors. Dialux, interface overview, model a project. Standards and AutoCAD, electrical Installation standards, definition of voltage ranges, the different ranges of voltage that exist, electrical protection classes, protection class "IP", mechanical Impact protection rating "IK", fire resistance rating, luminaire – incandescent wire test, the Bathrooms, Standards for electrical appliances in the bathroom, establishing an equipotential link. AutoCAD. Low voltage installation: ground connection diagrams, earth connections, Connecting the transformer neutral to the earth, Different types of electrical accidents, Ground connection diagrams. Power and minimum cross-section of a conductor, Installed Power, Absorbed Power, estimated installed power, Utilization Power, Choice of transformer power rating, Practical determination of the minimum cross-section of a conductor, voltage drop.
Prerequisite: Electrotechnics (020ETCES1).

020IE2ES3 Electrification 2 4 Cr.
Topics covered include: Short circuit current: three-phase short-circuit current at the secondary of a transformer MV/LV, three-phase short-circuit current at any point in a LV installation. Electrical panels & cables: description of electrical panels, types and forms of tables, composition of electrical panels, types of electrical cables, thermal stress of the cables, selection of protective devices. Disturbances due to harmonics: harmonics, reminder of the Fourier Series, harmonic pollution, the effects of harmonics and resonance, IEC Standards in the fight against harmonics, basic solutions to attenuate harmonics, measurement of harmonics in electrical networks. Software for the design and sizing of LV electrical installations: ECODIAL, draw a single-line diagram, make calculations, and make reports. Extra low voltage systems: telephone and TV system, residential telephone, telephone line, business phone system, VoIP, television and antennas, RG cables. Fire alarm system: operation and components, Addressable and conventional systems, fire alarm cable, maintenance, and evacuation plan. Surveillance System – CCTV: operation and advantages of CCTV, schematic diagram and components, CCTV cabling, maintenance. Lightning protection

system: lightning, lightning rod characteristics and operation, the different types of lightning rods, differences between lightning rod and surge arrester, rules to follow and isolation spark plugs.
Prerequisite: Electrification 1 (020IE1ES2).

020ETCES1 Electrotechnics 6 Cr.
The aim of this course is the study of three-phase electrical networks in balanced and unbalanced steady-state sinusoidal operation as well as single-phase and three-phase transformers. The course covers the dielectrics, conductors, magnetic materials used in electrotechnics, the operating and modeling of linear and nonlinear magnetic circuits without and with flux leakage and the effect of the airgap.
It also covers the modeling of three-phase balanced and unbalanced electrical networks operating in a sinusoidal regime by the method of the single-phase star equivalent scheme and the symmetrical components method. Finally, the principles of operation of single-phase and three-phase transformers are studied in order to establish their equivalent circuits and predetermine the values of the voltages, currents, powers, efficiency at no-load, short-circuit and load operations.
Prerequisites: Electromagnetism (020EMENI3 or 020EMECI3), Linear electrical systems and networks (020SRLNI4 or 020SRLCI4)

020SEMES3 Embedded Systems 4 Cr.
Topics covered include: 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 – FGPA: 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 the hardware and the software – NIOS II processor creation and programming.
Prerequisites: Digital Systems Design (020TEDNI4 or 020TEDCI4), Programming 1 (020IF1NI2 or 020IF1CI2)

020ANGES4 English 4 Cr.
This course is designed to develop critical thinking, reading, oral and writing skills. It focuses on synthesizing sources producing a research paper and defending it in front of an audience. Emphasis is on the analytical reading of different text types required in the disciplines as well as on synthesis from a variety of sources to produce a written text and present it orally.

020ENTES1 Entrepreneurship 2 Cr.
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.

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 went 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

020MEFES2 Fluid Mechanics 4 Cr.

Topics covered include: The fundamental elements for understanding incompressible fluid flow. Characteristics of fluids - Kinematics - Conservation equations - Study of viscous fluids – Dimensional analysis and similarity - Flow regimes - Laminar and turbulent flows in pipes. Euler and Bernouilli theorem - Navier-Stokes equations. Dimensional analysis applying the PI theorem.
Prerequisite: Mechanics 2 (020MC2CI3 or 020MC2NI3)

020LFLES5 Fuzzy Logic and Neural Networks 4 Cr.

In this course, two intelligent techniques for data processing drawn from complex and imprecise environment are presented and studied. Fuzzy Logic theory is based on the empirical aspect of the human reasoning, and is used in the manipulation of imperfect, imprecise, or approximate knowledge. It allows the modeling and processing of very complex systems in which, for example, human factors are present. Theory and applications concerning fuzzy logic have existed for more than fifty years. They cover several fields such as artificial intelligence, identification and control of dynamic systems, automatic decision-making in complex systems, and fault diagnosis in industrial processes. On the other hand, Artificial Neural Networks are based on the biological aspect of the human brain. They are currently widely applied in various sectors such as telecommunication systems, automation, robotics, image processing and recognition, artificial intelligence, medicine and economics.

020DOMES3 Home Automation 4 Cr.

Introduction to Home Automation. Communication mode: Dry contact, Serial, Infrared and TCP-IP. Protocol: Wired and Wireless, Dedicated and Universal. Type of control: Lighting, electrical curtains, HVAC and Audio video equipment. Interface with other systems: Building management systems (BMS), Fire Alarm, Intrusion, CCTV and intercom. Internet of things (IOT). User Interface: Binary input, Wired Keypads, Wireless remote control, Touch screen and Mobile / Tablet applications. Concept of electrical installation relative to home automation complete with the relative electrical panel. Load schedule with the number of circuits and type of control. Home Automation devices. KNX Protocol. ETS software. Concept of typical project (requirement and recommendations).

020CL1ES3 HVAC 1 4 Cr.

Thermal Comfort: Thermal and Hydrothermal Exchange - Interior Basic Conditions - Exterior Basic Conditions - Comfort Elements: Activity, Clothes, Hygrometry, Radiation, Temperatures - Psychometric Chart: Calculation and dimensioning of heating, Cooling, Humidifying, Dehumidifying systems for interior ambient - Load Estimation for Heating taking into account the Impacts of Ventilation, Wall insulation, Glazing treatment, Lighting and Equipment heating production, etc. - Central Heating using Hot Water: Presentation, Design and sizing of radiators, Fan-coils, Floor heating, Convectors, Pipes, Pumps, Boilers, Burners, Domestic hot water, Fuel tanks, Chimney, etc. - Heating with Hot Air: Production of hot air, Air handling unit, Fan coil unit - Presentation, Design and sizing using the psychometric chart of heating coils, Humidifiers, Air filters, Fans, Mixing box.
Prerequisites: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1), Thermodynamics 2 (020TH2CI4) or Introduction to Heat Transfer (020ITCNI3 or 020THENI3).

020CL2ES4 HVAC 2 4 Cr.

Heat pump – Mollier diagram – Environmental issues related to cooling fluids (Ozone and global warming) and new fluids – Summer thermal balance sheet – Cold battery and air evolution on cold batteries – Direct and indirect expansion air conditioning modes – Low and high-speed duct systems – Single and double flow and variable air flow.
Prerequisite: HVAC 1 (020CL1ES3).

020ELIES2 Industrial Electronics 6 Cr.

This course introduces students to the expanding field of power electronics in the domain of industrial applications. It is articulated around three 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. This main part is validated by workshops using MATLAB/Simulink, as well as a set of lab experiments. Finally, an application related to variable speed systems, and based on power-rectifiers is developed.
Prerequisite: Analog electronics (020ELAES1)

020GINES5 Industrial Engineering 4 Cr.

This course provides a general idea of the world of Industrial Engineering that electrical engineers need to know about. It provides a comprehensive view on the effect of labor on productivity, the effect of information system on the flow of work, the optimum experimental design and optimizing processes.

020PRNES4 Industrial Process and Control 4 Cr.

Topics covered include: 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.

020AULES2 Linear Control 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, as well as a set of lab experiments leading to the design and test of a linear control system.
Corequisite: Analog Electronics (020ELAES1) or Prerequisite: Electronics (020ELCES1).

020MLRES4 Machine Learning 4 Cr.

Machine learning (ML) is a subfield of Artificial intelligence. It is the science of making the machine learn by examples. The goal of ML is to make a computer that can learn from examples autonomously. The main research topics in ML include: Computer Vision (CV) and Natural Language Processing (NLP) and precision medicine for personalized treatments. The main goal of this course is to acquire a basic understanding of ML algorithms as well as hands-on ML engineering experience with regards to its application to realistic datasets through Python implementations that make use of state-of-the-art libraries such as Scikit-learn, Tensorflow and Keras.

020MNGES5 Management **2 Cr.**
This course is a study of management theories, emphasizing the management functions of planning, decision-making, organizing, leading and controlling.

020SMPES3 Microprocessor Systems **4 Cr.**
Difference between microprocessors, microcontrollers and DSP – microprocessor architecture; realization of a basic board – Microcontroller architecture (PIC 18F2520) – Implementation of ROM, RAM and DATA EEPROM memory – special registers – addressing modes – inputs/outputs – interrupts – timers – analog to digital converter – asynchronous serial port – read from program memory – comparators – watchdog – sleep mode – Low Voltage Detect – oscillator – configuration words – Design, simulation and realization of microprocessor systems.
Prerequisite: Digital Systems Design (020TEDNI4 or 020TEDCI4)

020CCIES4 Mixed-Signal IC Design **4 Cr.**
This course introduces the use of an industrial EDA Software tool to acquire computer-Aided Design skills in the field of Integrated Circuit Design. Topics covered include: IC Design Flow, Fabrication Technology and Packaging. Multi-stage Amplifiers, Current mirrors and Active Loads, Basic Biasing concepts, Differential signaling, Operational Amplifier Transistor-Level Design, Filters, Sampled circuits, Buffers, Frequency response of analog feedback circuits, Introduction to stability of feedback amplifiers, Simulation and Evaluation of the electrical performance of ICs using EDA Software. Introduction to Noise and Linearity in Electronics.
Prerequisite: Digital Electronics (020ELNES2)

020CTMES4 Modern Control **4 Cr.**
Modeling a multi-variable system, interpretation, and linearization. Response and matrix transfer. Realization in controllability, observability, and Jordan forms. Controllability, and its properties, partial controllability. Observability and its criteria. Minimum implementation, stabilization, and detection. Directions of the poles and zeros, simplification. Pole placement control, error integration, and observers. Optimal quadratic control (LQG): introduction, Riccati equation, Kalman filter, validity conditions. Guided mini project: modeling, design, and simulation.
Prerequisite: Linear control (020AULES2)

020PRMES4 Multidisciplinary Project **6 Cr.**
This project brings together students from different programs and/or options 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

020SNLES5 Nonlinear Systems 4 Cr.

This course is divided into two parts. The first part presents two analysis methods of nonlinear systems. The first method, characterized by its simplicity, is based on the describing function concept in the frequency domain. It makes use of basic elements already seen in linear systems analysis and control, which are extended to the nonlinear case. The second method is more rigorous and uses the concept of state variables and phase plane in the time domain. The stability theory of nonlinear systems study will be presented in both frequency and time domains (Loeb criterion, Lyapunov theorem). In the second part of the course, two nonlinear time-domain control techniques are presented: the sliding-mode control known by its robustness, and the feedback linearization control characterized by its precision. The advantages and drawbacks of these two control methods with respect to conventional techniques will be underlined. Their application in the control design of nonlinear industrial processes will also be illustrated.

020MENES1 Numerical Methods 4 Cr.

Introduction to numerical calculation, error analysis and propagation, numerical software, interpolation and approximation, integration and differentiation, numerical solution to differential equations, finite difference method, matrices, resolution of linear systems, matrix decomposition, eigenvalues and eigenvectors, non-linear system of equations.
Prerequisites: Linear Algebra (020ALNNI2) or Algebra 1 (020AL1CI2), Differential Calculus (020CDFNI4) or Analysis 2 (020AN2CI3).

020CPPES1 Object-Oriented Programming 6 Cr.

Topics covered include: C/C++ syntax: typed variable declarations, basic I/O, expressions, implicit and explicit type conversion, conditional branching, for and while loops, functions and prototypes, parameter passing and overloading. Arrays, strings, cyclic dependency resolution, references, pointers and manual memory management. Deep copy and smart pointers. The object-oriented paradigm: abstraction, encapsulation, inheritance and polymorphism. Definition of classes, constructors, destructors, attributes, methods, the “static” keyword, access modifiers and operator overloading. Development environment with VS Code. Compiling with CMake. Code versioning with git and github.
Prerequisite: Programming 2 (020IF2CI3 or 020IF2CI3)

020OPTES5 Optimization 4 Cr.

This course introduces optimization techniques tailored for electrical engineers. Students will learn to identify electrical engineering problems and formulate them as optimization problems by selecting appropriate objective functions and constraints and applying optimization algorithms to find optimal solutions. Topics include linear and nonlinear optimization, convex optimization, and heuristic methods.
Emphasis is placed on understanding mathematical foundations, algorithmic implementations, and practical applications in electrical engineering systems. Besides, students will learn to interpret and assess optimization results by comparing different optimization algorithms in terms of convergence speed, computational burden, and ability to find local/global minimum.

020PCBES5 PCB Design Fundamentals 4 Cr.
This course introduces the fundamentals of designing printed circuit boards (PCBs) using industrial EDA software tool. Students will learn the key concepts, tools, and techniques used in PCB design, including schematic capture, component placement, routing, design rules, and manufacturing considerations. The course also covers topics such as signal integrity, parasitic, coupling, controlled impedance and power distribution. Additionally, this course includes a project realization of a complex circuit using Proteus software.
Prerequisite: Digital Electronics (020ELNES2)

020PENES4 Power Generation 4 Cr.
The Power Generation course is designed to provide students with a deep insight into the various technologies and methodologies used to generate electrical power. It encompasses theoretical principles, practical applications, and the environmental considerations associated with power generation, specially the steam and gas power cycles. The course also covers the operating conditions of steam and gas cycles at design conditions and partial loads, as well as the economic and environmental aspects.
Prerequisite: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1).

020ANRES4 Power Systems Analysis 4 Cr.
This course introduces the students to the physical aspects of the electric transmission lines. It shows how to determine their equivalent mathematical model and calculate their structural parameters. Based on such model, performance study is elaborated in both permanent and transient regimes (power losses, voltage regulation, power factor, transient overvoltage). Compensation techniques to improve the power factor are presented. Numerical methods and algorithms for calculating the power flow are also explained and applied. Short-circuit analysis is detailed, and power system stability following short-circuit disturbance is discussed. In addition, methods for the selection of isolators and protection devices are exposed. Finally, the benefits of DC transmission systems and its technical aspect are presented.

020RPEES5 Profitability of Energy Projects 4 Cr.
This course enables students to understand, using economic tools, the profitability of an energy project. Topics covered include: Energy Efficiency Measures, Green Energy versus Gray Energy (Useful, Final, Secondary and Primary). Identification of the energy project and the financial package; Notions of Investment and technical and economic lifetimes; Annual Recipes and Earnings; Calculation of the Simple Return Time and return on investment; The energy return time; Simple cumulative profit in cash flow; Subsidy and financial incentives; Inflation; Cost of Energy Improvement; Cost of kWh in cash flow; Concept of discount and calculation of the discount rate; Present value and acquired value; Updated Return Time; Net Present Value (NPV); Internal Rate of Return (IRR); Annual Gains in Constant Annuity (AGCA); Economized Fuel Cost (EFC); Cost of kWh in cash flow and discounted (LCE); Integration of externalities into energy costs; Case studies.

020GPRES2 Project Management **4 Cr.**

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 purposes of this course are teaching students these successful techniques, and expose them to a variety of skills to manage the budget, schedule, and quality of projects that they are or will be responsible for.

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 about 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, participants will explore specific topics, including the Principles of Solar Radiation, PV system components, design, selection and sizing. The curriculum also explores the origin and power of wind, wind energy system components, turbine design and control, electrical aspects of wind turbines, and the essentials of wind energy system selection and 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 participants 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, actuator 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 will be presented. The principles of operation of various actuators will be discussed including pneumatic, magnetic, piezoelectric, linear, stepper, etc. Advanced feedback mechanisms will be implemented using software executing in an embedded system. The concepts for real-time processor programming will be also introduced. Image processing and artificial intelligence will be also presented in this course. Neural networks and advanced controllers will be 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 includes 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).

020SYSES2 Signals and Systems 4 Cr.
This course covers the basic concepts of signal processing and continuous and discrete systems such as the Fourier transform, distributions, Fourier series decomposition of periodic signals, Parseval's theorem, linear and invariant systems, linear filtering of continuous signals, linear and nonlinear distortions, sampling, Z transform, discrete time Fourier transform, truncation windows, discrete Fourier transform (DFT), Fast Fourier (FFT), recursive and non-recursive digital filters, synthesis of recursive and non-recursive filters.
Prerequisite: Differential calculus (020CDFNI4) or Analysis 2 (020AN2CI3)

020SSTES4 Space and Micro/Nano Satellite Technologies 4 Cr.
Topics covered include: 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 the 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 software's, STK tracker software, design and implement (tabletop) a nanosatellite type Cubesat 1U using commercial components and boards.
Prerequisites: Analog Electronics (020ELAES1) and 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).

020IPRES5 System Identification 4 Cr.
Topics covered include: Course introduction. Plants and systems models: type of models and representation methods. Identification of nonparametric models in the time and frequency domains: correlation method, Fourier analysis, spectral analysis, closed loop identification. Pseudo ransom binary signal: properties and design for identification purposes. Parametric model's identification: least squares technique, recursive, weighted, instrumental variables,

etc. MATLAB Identification Toolbox. Workshops using MATLAB/Simulink. Experimental identification and control of a linear system.
Prerequisite: Digital systems and control (020SCNES3)

020EVVES4 Variable Speed Drives **6 Cr.**
This course aims to introduce the multiple control possibilities offered by variable speed drives for the three main types of motors in the electrical engineering field. Topics covered include: I) Variable speed DC machine: Four-quadrant operation, Four-quadrant three-phase rectifier with no circulating current, Speed control using cascaded loops, Current loop and speed loop. II) Variable speed induction machine: Steady-state equivalent circuit at high frequencies, Torque harmonics, Scalar control of a squirrel-cage induction machine, Vector control of a squirrel-cage induction machine, introduction to DTC control of an induction machine. III) Variable speed synchronous drives: introduction to the scalar control and the vector control of synchronous drives. All three case studies are simulated and validated using Matlab/Simulink software.
Prerequisites: Linear control (020AULES2), Electric machines 2 (020ME2ES4)

020CM2ES4 Wheeled Robots **4 Cr.**
This course provides in-depth coverage of wheeled mobile robots. Topics covered include (i) nonholonomy and integrability of kinematics constraints; (ii) modelling: kinematics, dynamics, and state-space representation; (iii) nonlinear control strategies (open-loop and closed-loop), and (iv) simulation using the virtual wheeled mobile robots' laboratory. Four architectures are covered: differential-drive robot, Ackermann-based steering robot, Articulated-based steering robot, and mobile wheeled pendulum.

020WRNES1 Work Ready Now **2 Cr.**
Personal Development - Communication Skills - Job Seeking Skills - Work Behaviors.

BACHELOR OF ENGINEERING IN INDUSTRIAL ENGINEERING

Main Language of Instruction:

French: ◙	English □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The Bachelor of Engineering in Industrial Engineering aims to graduate students able 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)

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

Program Requirements

180 credits: Required courses (150 credits), Institution’s elective courses (26 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits - part of the above categories).

Fundamental Courses

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 Internships (2 Cr.) – During their studies, each student can complete two internships:

- A recommended labor internship of at least 4 weeks at the end of the third year of studies.
- A required technical internship of 6 to 10 weeks at the end of the fourth year of studies (2 Cr.).

Multidisciplinary Project (6 Cr.)

This project brings together students from different programs and/or options 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

Final Year Project (16 Cr.)

The final year project is carried out by groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and two oral presentations are the main deliverables of the project.

Institution’s Elective Courses (26 Cr.)
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.)
Arabic Culture and Language (2 Cr.). One Open Elective Course (2 Cr.)

USJ General Education Program (26/36 Cr.)

10 additional credits are earned at the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGES4	English	4
	ARABIC	**4**
	Arabic Language and Culture	***2***
	One Arabic Culture and Language course to be selected among:	2
435LALML2	Arabic Language and Media	
435LALAL2	Arabic Language and Arts	
435LRCTL2	Arabic Language: Contemporary Novel, Cinema, and Theater	
	Other Courses 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***
	One Institution's elective course to be selected between:	2
020ENTES1	Entrepreneurship	
020WRNES1	Work Ready Now	
	Other Social Sciences Courses	***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

Semester 1

Code	Course Name	Credits
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
	Institution's Elective course: Work Ready Now or Entrepreneurship	2
	Total	**32**

Semester 2

Code	**Course Name**	**Credits**
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: Arabic Language and Culture	2
	Total	**34**

Semester 3

Code	**Course Name**	**Credits**
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 4

Code	**Course Name**	**Credits**
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	2
	Total	**34**

Semester 5

Code	**Course Name**	**Credits**
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 6

Code	Course Name	Credits
020PFEES6	Final Year Project	16
	Total	**16**

Course Description

020CMPES5 Accounting 4 Cr.
Topics covered include: 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 destined to work in public or private companies and in all fields. Its objective is to create awareness for the need of 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 it.

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.
Topics covered include: A panorama of Cloud technologies and industry and its positioning into the IT landscape. What are the fundamentals of the Cloud and how it disrupts the way IT is purchased, consumed and operated. What is the definition of the Cloud, how is that different from traditional IT technically, economically, organizationally and for business efficacy and innovation. Who are the players and what are 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 Cloud.

020TCOES2 Communication Skills 2 Cr.
Communication is of high importance for an engineering student. Indeed, whether in academic or professional activities, transmitting information is a powerful tool for convincing and even influencing others. Communication is unavoidable, but it comes with many errors and risks that should be avoided. Otherwise, the reception of the information may be disturbed and misunderstood. This course offers students the knowledge of essential basic rules of main ways of communication (written, verbal and non-verbal) and makes them aware of the 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 implantation of digital controllers using embedded system 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.

Topics covered include: 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 outcome. 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 Spreadsheet like Excel and data investigation like Access. The course also considers the underlying industrial processes. It prepares students for both technology-intensive professions, e.g. system development (ERD software drawing will be used like Visio), 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. We first cover 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 its 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.

Topics covered include: 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.

Topics covered include: 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 – FGPA: 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 the hardware and the software – NIOS II processor creation and programming.

Prerequisites: Digital Systems Design (020TEDNI4 or 020TEDCI4), Programming 1 (020IF1NI2 or 020IF1CI2)

020ENEES2 Engineering Economics 6 Cr.

Topics covered include: 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 producing a research paper and defending it in front of an audience. Emphasis is on the analytical reading of different text types required in the courses as well as on synthesis from a variety of sources to produce a written text and present it orally.

020ENTES1 Entrepreneurship **2 Cr.**

Topics covered include: 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 to 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 went 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 is an introductory course to 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 concepts : 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 and deployment of end-to-end IoT chain.

020PRNES4 Industrial Process and Control 4 Cr.

Topics covered include: 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.

020GSTES3 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 ou 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, layer-design, 3D printing and nanotechnologies.
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 are presented. Topics include: 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
Prerequisites: Production Control (020GEPES3).

020STMES1 Mechanical Structures 6 Cr.
This course introduces to 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.
Prerequisite: 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 options 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 went 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.
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 purposes of this course are teaching students these successful techniques, and expose 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 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 about 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, participants will explore specific topics, including the Principles of Solar Radiation, PV system components, design, selection & sizing. The curriculum 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 participants 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, actuator 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 will be presented. The principles of operation of various actuators will be discussed including pneumatic, magnetic, piezoelectric, linear, stepper, etc. Advanced feedback mechanisms will be implemented using software executing in an embedded system. The concepts for real-time processor programming will be also introduced. Image processing and artificial intelligence will be also presented in this course. Neural networks and advanced controllers will be 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.**

Topics covered include: 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 the 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 software's, STK tracker software, design and implement (tabletop) a nanosatellite 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.

Topics covered include: Personal Development - Communication Skills - Job Seeking Skills - Work Behaviors.

BACHELOR OF ENGINEERING IN MECHANICAL ENGINEERING

Main Language of Instruction:

French: ◙	English □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The Bachelor of Engineering in Mechanical Engineering aims to graduate students able 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)

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

Program Requirements

180 credits: Required courses (162 credits), Institution’s elective courses (14 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits - part of the above categories)

Fundamental Courses

Required Courses (162 Cr.)

Accounting (4 Cr.)

Automobile (4 Cr.)
Business Ethics (4 Cr.)
Business Law (2 Cr.)
Communication Skills (2 Cr.)
Computer Aided Drawing and Design (CADD) (4 Cr.)
C++ Programming (4 Cr.)
Electronics (6 Cr.).
English Level A (4 Cr.)
Finite Elements for Mechanical Applications (4 Cr.)
Fluid Mechanics (6 Cr.).
Heat Transfer (6 Cr.)
HVAC 1 (4 Cr.)
Hydraulics (4 Cr.)
Innovation and Design Thinking (2 Cr.)
Introduction to Electric Machines (4 Cr.)
Linear Control (6 Cr.)
Machine Design 1 (4 Cr.)
Management (2 Cr.)
Mechanical Systems (6 Cr.)
Mechanical Vibrations (4 Cr.)
Numerical Methods (4 Cr.)
Plumbing (4 Cr.)
Project Management (4 Cr.)
Renewable Energy for Mechanical Engineering (4 Cr.)
Sensors and Instrumentation (4 Cr.)
Statistics (4 Cr.)
Strength of Materials (6 Cr.)
Thermodynamics: Principles and Applications (6 Cr.)

For the Energy Option:
HVAC 2 (4 Cr.)
Power Generation (4 Cr.)
Thermal Engines (4 Cr.)
Turbomachines (4 Cr.)

For the Mechanical Design Option:
Advanced Strength of Materials (4 Cr.)
Design of Mechanisms (4 Cr.)
Manufacturing Processes 1 (4 Cr.)
Selection and Properties of Materials (4 Cr.)

For the Mechatronics Option:
Design of Mechatronic Systems (4 Cr.)

Micro-Electro-Mechanical Systems (MEM) (4 Cr.)
Microprocessors for Mechatronic Applications (4 Cr.)
Modern Control (4 Cr.)

Corporate Internships (2 Cr.) – During their studies, each student can complete two internships:

- A recommended labor internship of at least 4 weeks at the end of the third year of studies.
- A required technical internship of 6 to 10 weeks at the end of the fourth year of studies (2 Cr.).

Multidisciplinary Project (6 Cr.)

This project brings together students from different programs and/or options 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

Final Year Project (16 Cr.)

The final year project is carried out by groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and two oral presentations are the main deliverables of the project.

Institution's Elective Courses (14 Cr.)

Four courses are to be selected from the required courses of the other two options or from the following list:

Acoustics and Vibrations (4 Cr.)
Advanced Materials Science (4 Cr.)
Aerodynamics (4 Cr.)
Artificial Intelligence (4 Cr.)
Automotive Propulsion Systems (4 Cr.)
Biomechanics (4 Cr.)
Dynamic Systems Modeling (4 Cr.)
Energy Optimization (4 Cr.)
Entrepreneurship (2 Cr.)

Fluid Power Systems (4 Cr.)
Home Automation (4 Cr.)
Hydraulic Servo Systems (4 Cr.)
Machine Design 2 (4 Cr.)
Machine Learning (4 Cr.)
Manufacturing Processes 2 (4 Cr.)
Mechanics of Composite Materials (4 Cr.)
Mechatronics and Intelligent Machines (4 Cr.)
Numerical Fluid Mechanics (CFD) (4 Cr.)
Pollution, Environment and Sustainability (4 Cr.)
Profitability of Energy Projects (4 Cr.)
Refrigeration Systems (4 Cr.)
Robotics (4 Cr.)
Wheeled Robots (4 Cr.)
Work Ready Now (2 Cr.)

Open Elective Courses (4 Cr.)
Arabic Culture and Language (2 Cr.)
One Open Elective Course (2 Cr.)

USJ General Education Program (26 Cr. out of 36 Cr.)

10 additional credits are earned at 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 Courses 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	One Institution’s elective course to be selected between: Entrepreneurship	2

020WRNES1	Work Ready Now	
	Other Social Sciences Courses	***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

Semester 1

Code	**Course Name**	**Credits**
020PCPES2	C++ Programming	4
020ELCES1	Electronics	6
020MEFES1	Fluid Mechanics	6
020STAES1	Statistics	4
020RDMES1	Strength of Materials	6
020TPAES1	Thermodynamics: Laws and Applications	6
	Institution's Elective course: Work Ready Now or Entrepreneurship	2
	Total	**34**

Semester 2

Code	**Course Name**	**Credits**
020TCOES4	Communication Skills	2
020TRCES2	Heat Transfer	6
020CL1ES2	HVAC 1	4
020IMEES1	Introduction to Electric Machines	4
020SMEES1	Mechanical Systems	6
020VMEES2	Mechanical Vibrations	4
020MENES2	Numerical Methods	4
	Open Elective: Arabic Language and Culture	2
	Total	**32**

Semester 3

Code	**Course Name**	**Credits**
020AUTES3	Automobile	4
020CAOES2	Computer Aided Drawing and Design (CADD)	4
020HYDES3	Hydraulics	4
020AULES2	Linear Control	6
020CM1ES3	Machine Design 1	4

020CEIES3	Sensors and Instrumentation	4
	For the Energy Option (8 Cr.)	
020CL2ES4	HVAC 2	4
020TRBES3	Turbomachines	4
	For the Mechanical Design Option (8 Cr.)	
020CPMES3	Design of Mechanisms	4
020PF1ES3	Manufacturing Processes 1	4
	For the Mechatronics Option (8 Cr.)	
020MEMES5	Micro-Electro-Mechanical Systems (MEM)	4
020MAMES3	Microprocessors for Mechatronic Applications	4
	Total	**34**

Semester 4

Code	**Course Name**	**Credits**
020ETHES3	Business Ethics	4
020ANGES4	English	4
020PRMES4	Multidisciplinary Project	6
020GPRES2	Project Management	4
020PLBES4	Plumbing	4
	For the Energy Option (4 Cr.)	
020MOTES4	Thermal Engines	4
	For the Mechanical Design Option (4 Cr.)	
020RMAES4	Advanced Strength of Materials	4
	For the Mechatronics Option (4 Cr.)	
020CTMES4	Modern Control	4
	Institution’s Elective course	8
	Open Elective	2
	Total	**32**

Semester 5

Code	**Course Name**	**Credits**
020CMPES5	Accounting	4
020DRAES5	Business Law	2
020STGES5	Corporate Internship	2
020ELFES4	Finite Elements for Mechanical Applications	4
020INDES2	Innovation and Design Thinking	2
020MNGES5	Management	2
020ERMES5	Renewable Energy for Mechanical Engineering	4
	For the Energy Option (4 Cr.)	
020PENES4	Power Generation	4

020SPMES4	*For the Mechanical Design Option (4 Cr.)* Selection and Properties of Materials	4
020CSMMS4	*For the Mechatronics Option (4 Cr.)* Design of Mechatronic Systems	4
	Institution's Elective course	8
	Total	**32**

Semester 6

Code	Course Name	Credits
020PFEES6	Final Year Project	16
	Total	**16**

Course Description

020CMPES5 Accounting 4 Cr.
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.

020AEVES4 Acoustics and Vibrations 4 Cr.
This course covers the fundamental concepts in noise and vibrations, the vibrations of bars, beams, and membranes, passive and active damping strategies, damping materials, control methods; and applications.
Prerequisite: Mechanical Vibrations (020VMEES2) or Vibrations (020VIBES2).

020SMAES4 Advanced Materials Science 4 Cr.
This course deals with metals and polymers. The ferrous and non-ferrous alloys section covers the following aspects: mechanical behavior of metals, phase diagrams; fabrication of metals, heat treatment, surface properties of metals; plastic deformation, elements of fracture mechanics; and process-structure-property relationships. The polymers' part covers their properties, polymerization and synthesis, characterization techniques, physical properties of polymers, viscoelasticity, mechanical properties and applications.
Prerequisite: Introduction to Materials Science (020ISMNI2).

020RMAES4 Advanced Strength of Materials 4 Cr.
This course focuses on the study of stresses resulting from combined loadings, beam deflection, principal stresses, and absolute maximum shear stress. It also covers experimental methods for determining deformation, column buckling, and static failure theories. Students will explore statically indeterminate problems, which are common in real-world scenarios and cannot be solved using statics alone. The course introduces various solution methods, including integration, superposition, and Clapeyron's theorem, to determine reactions at the

supports of statically indeterminate members under tension, torsion, bending, and buckling. Additionally, the course covers the virtual work theorem, energy methods, static failure theories, and the three-dimensional state of stress using Mohr's circle. Topics also include stresses in thin-walled pressure vessels, composite and curved beams, shear centers, and asymmetric bending. The course further addresses the plastic analysis of bars, beams, and shafts with elastic-perfectly plastic material, as well as two-dimensional problems in elasticity.
Prerequisite: Strength of Materials (020RDMES1) or Strength of Materials 1 (020RM1ES2).

020ARDES3 Aerodynamics 4 Cr.
This course covers theoretical and empirical methods for calculating the loads on airfoils and finite wings by application of classical potential theory, thin airfoil approximations, lifting line and lifting surface theory, and panel methods; wings and airplanes; application of linearized supersonic flow to supersonic airfoils; performance and constraint analysis; longitudinal stability and control.
Prerequisite: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1).

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.

020IA3ES4 Artificial Intelligence 4 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). It then introduces Machine Learning (ML) algorithms with some applications such as regression and classification. Finally, these algorithms are applied to realistic datasets via Python implementations using libraries such as Scikit-learn, Tensorflow and Keras.

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 Systems (020SMEES1) or Mechanical Structures (020STMES1).

020SPAES5 Automotive Propulsion Systems **4 Cr.**
This course covers the basics of transmission systems and ground propulsion, energy consumption and the environmental impact of modern means of transport, configuration of conventional vehicle propulsion systems, principles of operation of conventional propulsion systems, technologies of propulsion systems for battery electric vehicles, technologies of propulsion systems of fuel cell vehicles, hybrid electric powertrain technologies, stop/start of hybrid, parallel hybrid and series/parallel hybrid drive systems.
Prerequisites: Automobile (020AUTES3), Thermal Engines (020MOTES4).

020BIMES3 Biomechanics **4 Cr.**
This course explores the biomechanical principles underlying the kinetics and kinematics of both normal and abnormal human motion, with an emphasis on the interaction between biomechanical and physiological factors (bones, joints, connective tissues, and muscle physiology and structure) in skeletal and motor function. It also covers applications in testing and rehabilitation practice. Additionally, the course introduces constitutive equations, stress-strain relationships for biomaterials, rheological properties of blood, and the biomechanics of blood vessels and the heart.
Prerequisites: Introduction to Materials Science (020ISMNI2), 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 destined to work in public or private companies and in all fields. Its objective is to create awareness for the need of 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 it.

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.

020TCOES2 Communication Skills 2 Cr.
Communication is of high importance for an engineering student. Indeed, whether in academic or professional activities, transmitting information is a powerful tool for convincing and even influencing others. Communication is unavoidable, but it comes with many errors and risks that should be avoided. Otherwise, the reception of the information may be disturbed and misunderstood. This course offers students the knowledge of essential basic rules of main ways of communication (written, verbal and non-verbal) and makes them aware of the 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.

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.
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).

020CPMES3 Design of Mechanisms **4 Cr.**

This course focuses on the graphical and analytical synthesis of linkage mechanisms to one or more loops for the generation of movements, trajectories and generation of functions from 2-3-4 and 5 precision positions; optimal synthesis of linkage mechanisms; synthesis of cam-follower mechanisms; synthesis of gear trains.
Prerequisite: Mechanical Systems (020SMEES1).

020CSMMS4 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.
Prerequisites: Sensors and Instrumentation (020CEIES3), Microprocessors for Mechatronic Applications (020MAMES3).

020MSDES1 Dynamic Systems Modeling **4 Cr.**

The aim of this course is to introduce and train students to the crucial importance of modeling and analysis in the industry nowadays that leads to performance improvement, better time management and manufacturing cost reduction of a given product. These goals are taught through examples of electrical, mechanical, thermal, and complex systems. Pre-sizing, modeling, analysis of operation and performance are performed through simulations using the advanced software MATLAB/Simulink. This course initiates engineering design to students through iterative improvements, feasibility study and process optimization before the usual industrial prototyping.
Prerequisite: Matlab (020MATNI4).

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).

020OEPES5 Energy Optimization **4 Cr.**

This course examines the energy audit methods for industrial processes and the systematic mathematical methods of energy efficiency and energy, economic and environmental optimization of these processes by the application of the pinch method. The pinch method is a relatively recent method (it dates back to the 1980s), which makes it possible to determine

the most efficient network of heat exchangers and utilities in an energy installation or an industrial process. It is based on thermodynamic principles and on the study of the thermal heat transfer between the streams to be cooled (availability) and heated (needs). It makes it possible to minimize the internal irreversibility of the heat exchanger network, and thus to improve its performance.
Prerequisite: Heat Transfer (020TRCES2).

020ANGES4 English 4 Cr.
This course is designed to develop critical thinking, reading, oral and writing skills. It focuses on synthesizing sources producing a research paper and defending it in front of an audience. Emphasis is on the analytical reading of different text types required in the courses as well as on synthesis from a variety of sources to produce a written text and present it orally.

020ENTES1 Entrepreneurship 2 Cr.
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.

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 went 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.

020ELFES4 Finite Elements for Mechanical Applications 4 Cr.
The finite element method is a widely used numerical simulation technique in engineering and research across various technical and scientific fields. The objective of this course is to introduce students to the theoretical foundations and numerical implementation of the finite element method, with a focus on problems in the mechanics of materials and heat transfer. Students will learn to solve second-order differential equations in one and two dimensions with one or two variables. The course covers the stiffness method and/or weak formulations to derive finite element models. Applications include problems involving bars, trusses, beams, heat exchangers, frames, and plane stresses and strains in elasticity. Both symmetric and asymmetric problems are also addressed. Additionally, the course enables students to effectively use finite element software (Abaqus) and interpret and validate results.
Prerequisites: Numerical Methods (020MENES1), Strength of Materials (020RDMES1) or Strength of Materials 1 (020RM1ES2).

020MEFES1 Fluid Mechanics 6 Cr.

This course provides an in-depth understanding of fluid mechanics principles and their applications in mechanical engineering. Students will explore the fundamental concepts of fluid behavior, fluid statics, fluid dynamics, and the practical aspects of fluid flow in mechanical processes. The course emphasizes the analysis and design of fluid systems, including the fundamental elements for understanding incompressible and compressible fluid flow using mass, momentum, energy conservation principles and resolution of the characteristic fluid flow equations through the application of analytical and analogous methods.
Prerequisite: Mechanics 2 (020MC2CI3 or 020MC2NI3).

020OFPES4 Fluid Power Systems 4 Cr.

This course provides an overview of the latest technologies and developments in fluid power systems, as well as the diversity of their applications. It aims to make students aware of the potential and specificities of the application of different systems and components in the engineering world, from aviation to industrial machinery. The covered topics are technology, operation, maintenance, troubleshooting, design and analysis of different fluid power systems and their components, such as positive displacement pumps and motors, hydraulic actuators and servomechanisms, different types of valves (pressure and flow regulating valves), selector valves, servo-valves, different filtration and fluid conditioning systems, electric and automatic control components and sensors for different fluid power systems.
Prerequisites: Hydraulics (020HYDES3), Computer Assisted Drawing (020DAMNI4 or 020DAMCI4).

020TRCES2 Heat Transfer 6 Cr.

The course covers the fundamental concepts and conduction, convection and heat transfer by radiation, as well as their application to the solution of thermal engineering problems. The course also covers stationary thermal conduction and transient regime; flat surfaces; numerical simulations of conduction in one-dimensional and two-dimensional problems; external and internal forced convection applied to laminar and turbulent flows; natural convection; principles of the heat exchanger; and thermal radiation, form factors and radiation exchange between diffuse and gray surfaces.
Prerequisite: Introduction to Heat Transfer (020ITCNI3 or 020THENI3) or Thermodynamics 2 (020TH2CI4).

020DOMES3 Home Automation 4 Cr.

Introduction to Home Automation. Communication mode: Dry contact, Serial, Infrared and TCP-IP. Protocol: Wired and Wireless, Dedicated and Universal. Type of control: Lighting, electrical curtains, HVAC and Audio video equipment. Interface with other systems: Building management systems (BMS), Fire Alarm, Intrusion, CCTV and intercom. Internet of things (IOT). User Interface: Binary input, Wired Keypads, Wireless remote control, Touch screen and Mobile / Tablet applications. Concept of electrical installation relative to home automation complete with the relative electrical panel. Load schedule with the number of circuits and type of control. Home Automation devices. KNX Protocol. ETS software. Concept of typical project (requirement and recommendations).

020CL1ES3 HVAC 1 4 Cr.

Thermal Comfort: Thermal and Hydrothermal Exchange - Interior Basic Conditions - Exterior Basic Conditions - Comfort Elements: Activity, Clothes, Hygrometry, Radiation, Temperatures - Psychometric Chart: Calculation and dimensioning of heating, Cooling, Humidifying, Dehumidifying systems for interior ambient - Load Estimation for Heating taking in account the Impacts of Ventilation, Wall insulation, Glazing treatment, Lighting and Equipment heating production, etc. - Central Heating using Hot Water: Presentation, Design and sizing of radiators, Fan-coils, Floor heating, Convectors, Pipes, Pumps, Boilers, Burners, Domestic hot water, Fuel tanks, Chimney, etc. - Heating with Hot Air: Production of hot air, Air handling unit, Fan coil unit - Presentation, Design and sizing using the psychometric chart of heating coils, Humidifiers, Air filters, Fans, Mixing box.
Prerequisites: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1), Thermodynamics 2 (020TH2CI4) or Introduction to Heat Transfer (020ITCNI3 or 020THENI3).

020CL2ES4 HVAC 2 4 Cr.

Heat pump – Mollier diagram – Environmental issues related to cooling fluids (Ozone and global warming) and new fluids – Summer thermal balance sheet – Cold battery and air evolution on cold batteries – Direct and indirect expansion air conditioning modes – Low and high-speed duct systems – Single and double flow and variable air flow.
Prerequisite: HVAC 1 (020CL1ES3).

020HYDES3 Hydraulics 4 Cr.

This course focuses on steady-state and transient flows. Based on an in-depth approach to pressure losses, special attention is paid to the design of simple and complex networks. The safety of networks is approached by the study of transient regimes and the sizing of adequate protections. Extended network analysis is undertaken by studying pumps and turbines.
Prerequisite: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1).

020SSHES5 Hydraulic Servo Systems 4 Cr.

This course covers the fundamentals of modeling and control of hydraulic servosystems. It provides theoretical background and practical techniques for the modeling, identification and control of hydraulic servosystems. Classical and advanced control algorithms are discussed. The use of MATLAB/Simulink and other programming languages will be an integral part in this course.
Prerequisites: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1), Linear Control (020AULES2).

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.

020IMEES1 Introduction to Electric Machines 4 Cr.

This course introduces the following topics: Magnetic materials and circuits - Three-phase regimes - 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.
Prerequisite: Electromagnetism (020EMENI3 or 020EMECI3).

020AULES2 Linear Control 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, as well as a set of lab experiments leading to the design and test of a linear control system.
Corequisite: Analog Electronics (020ELAES1) or Prerequisite: Electronics (020ELCES1).

020CM1ES3 Machine Design 1 4 Cr.

This course covers fundamental mechanical design topics, such as static and fatigue failure theories, analysis of shafts, bearings and gears. In addition to fatigue failure criteria and S-N diagrams, it also covers surface failure, contact stresses, and static and fatigue stress concentrations. Students will learn to design the common elements of the machines which are studied by emphasizing their behavior under static and dynamic loads. The elements concerned in this course are represented by the transmission shaft, the keys and the couplings, the bearings and lubrication, and the spur gears.
Prerequisites: Strength of Materials (020RDMES1) or Strength of Materials 1 (020RM1ES2), Mechanical Systems (020SMEES1).

020CM2ES4 Machine Design 2 4 Cr.

This course is a continuation of Machine Design 1. Students will further develop their skills in designing and sizing mechanical components in machines, including helical, bevel, and worm

gears, as well as brakes, clutches, flywheels, and flexible mechanical elements. The course also covers the design of tension, compression, and torsion springs, screws and fasteners, and welds. Additionally, students will be introduced to planetary gear trains and differential transmissions. The course emphasizes the study of mechanical components in relation to static and dynamic loads, as well as vibration phenomena.
Prerequisites: Machine Design 1 (020CM1ES3), Mechanical Vibrations (020VMEES2) or Vibrations (020VIBES2).

020MLRES4 Machine Learning 4 Cr.
Machine learning (ML) is a subfield of Artificial intelligence. It is the science of making the machine learn by examples. The goal of ML is to make a computer that can learn from examples autonomously. The main research topics in ML include Computer Vision (CV), Natural Language Processing (NLP) and precision medicine for personalized treatments. The main goal of this course is to acquire a basic understanding of ML algorithms as well as hands-on ML engineering experience with regards to its application to realistic datasets through Python implementations that make use of state-of-the-art libraries such as Scikit-learn, Tensorflow and Keras.

020MNGES5 Management 2 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). In addition, 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, layer-design, 3D printing and nanotechnologies.

Prerequisite: Manufacturing Processes 1 (020PF1ES3).

020SMEES1 Mechanical Systems 6 Cr.
This course allows students to establish the link between solid kinematics and mechanical construction. It covers the modeling and resolution of problems relating to mechanisms made of non-deformable/rigid bodies: bar-linkages and associated kinematics, kinematic diagram, parameterization, analysis of operation, determination of equations of motion (positions, speeds and accelerations), calculation of the forces applied to the parts and the generated and dissipated mechanical energies. It also introduces students to the fundamentals and principles of multi-bar connections, gears and cams. Modeling of several bar systems on SolidWorks will be carried out to study and visualize the movements of the mechanisms.
Prerequisites: Computer Assisted Drawing (020DAMCI4 or 020DAMNI4), Mechanics 2 (020MC2CI3 or 020MC2NI3).

020VMEES2 Mechanical Vibrations 4 Cr.
This course covers the vibrations of one-dimensional systems (1 Degree of Freedom), including undamped free oscillations, undamped forced oscillations, free damped oscillations, forced damped oscillations, stability, resonance, and systems with multiple degrees of freedom, with a focus on mechanical engineering applications and examples. Students will learn how to model a system and analyze its vibrational behavior. Linear systems with multiple degrees of freedom are solved using the mode superposition and modal analysis methods. The course also introduces non-linear systems, resolution through iterative methods, and vibration suppression techniques.
Prerequisite: Mechanics 2 (020MC2CI3 or 020MC2NI3).

020MMCES4 Mechanics of Composite Materials 4 Cr.
This course focuses on anisotropic elasticity and laminate theory, the analysis of various members of composite materials, energy methods, failure theories, and micromechanics. It also introduces materials and fabrication processes.
Prerequisites: Introduction to Materials Science (020ISMNI2), Strength of Materials (020RDMES1) or Strength of Materials 1 (020RM1ES2).

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: Linear Control (020AULES2).

020MEMES5 Micro-Electro-Mechanical Systems (MEM) 4 Cr.
A course on sensors, sensor noise and sensor fusion; actuators; system models and automated computer simulation; information, perception, and cognition; planning and control; architectures, design, and development.

Prerequisite: Electronics (020ELCES1).

020MAMES3 Microprocessors for Mechatronic Applications 4 Cr.
Difference between microprocessors, microcontrollers and DSP – microprocessor architecture ; realization of a basic board – Microcontroller architecture (PIC 18F2520) – Implementation of ROM, RAM and DATA EEPROM memory – special registers – addressing modes – inputs/outputs – interrupts – timers – analog to digital converter – asynchronous serial port – read from program memory – comparators – watchdog – sleep mode – Low Voltage Detect – oscillator – configuration words – Design, simulation and realization of microprocessor systems.
Prerequisite: Electronics (020ELCES1).

020CTMES4 Modern Control 4 Cr.
Modeling a multi-variable system, interpretation, and linearization. Response and matrix transfer. Realization in controllability, observability, and Jordan forms. Controllability, and its properties, partial controllability. Observability and its criteria. Minimum implementation, stabilization, and detection. Directions of the poles and zeros, simplification. Pole placement control, error integration, and observers. Optimal quadratic control (LQG): introduction, Riccati equation, Kalman filter, validity conditions. Guided mini project: modeling, design, and simulation.
Prerequisite: Linear control (020AULES2).

020PRMES4 Multidisciplinary Project 6 Cr.
This project brings together students from different programs and/or options 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 went through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

020MFNES5 Numerical Fluid Mechanics (CFD) 4 Cr.
Computational fluid dynamics (CFD) is a technology based on a fast and reliable calculation methodology for solving complex fluid flow and heat transfer problems. This course introduces the fundamentals and practical technical applications of CFD. Although it provides an overview of some of the fundamental mathematical equations governing fluid flow and heat transfer phenomena, it emphasizes the application of the knowledge gained in the practical use of commercial CFD codes. The course provides a detailed explanation of setting up, running and interpreting CFD model results for different ANSYS Fluent® case studies.
Prerequisite: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1).

020MENES1 Numerical Methods 4 Cr.
Introduction to numerical calculation, error analysis and propagation, numerical software, interpolation and approximation, integration and differentiation, numerical solution to

differential equations, finite difference method, matrices, resolution of linear systems, matrix decomposition, eigenvalues and eigenvectors, non-linear system of equations.
Prerequisites: Linear Algebra (020ALNNI2) or Algebra 1 (020AL1CI2), Differential Calculus (020CDFNI4) or Analysis 2 (020AN2CI3).

020PLBES4 Plumbing 4 Cr.
The aim of this course is to furnish students with a comprehensive understanding of plumbing applicable to various building structures. Students will possess the requisite knowledge to adapt to international plumbing standards and comprehend their diverse applications. They will gain insight into French standards based on the DTU (Unifier Technical Document), American standards, including the NFPA "National Fire Protection Association" standard for firefighting. The key topics covered in this course include calculations for the dimensions of water distribution pipes, the selection of pipe types, calculations for the dimensions of evacuation pipes, sizing of booster pumps and their operational mechanisms, rainwater calculations, sizing of domestic hot water tanks, and understanding fire hoses for sprinkler systems and fire cabinets, including their operational principles.
Prerequisite: Hydraulics (020HYDES3).

020PEDES5 Pollution, Environment and Sustainability 4 Cr.
This course provides an overview of the causes and effects of global climate change, covering the basic science, projected impacts, and approaches to mitigation. It also includes methods for quantifying greenhouse gas emissions, controlling these emissions, and adapting to them, particularly in the HVAC/heating systems and building materials sectors. The course introduces the natural and anthropogenic carbon cycles, as well as carbon and climate concepts. Topics also cover the basics of green buildings, green materials for construction, material selection for sustainable design, green building certification, and methods for increasing energy efficiency in buildings. Additionally, the course includes the quantification of air, water, and soil pollution and their sources, sustainable wastewater treatment, solid waste management (sources and impacts), the zero-waste concept, and the 3R concept.

020PENES4 Power Generation 4 Cr.
The Power Generation course is designed to provide students with a deep insight into the various technologies and methodologies used to generate electrical power. It encompasses theoretical principles, practical applications, and the environmental considerations associated with power generation, especially the steam and gas power cycles. The course also covers the operating conditions of steam and gas cycles at design conditions and partial loads, as well as the economic and environmental aspects.
Prerequisite: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1).

020RPEES5 Profitability of Energy Projects 4 Cr.
This course enables students to understand, using economic tools, the profitability of an energy project. Topics covered include: Energy Efficiency Measures, Green Energy versus Gray Energy (Useful, Final, Secondary and Primary). Identification of the energy project and the financial package; Notions of Investment and technical and economic lifetimes; Annual

Recipes and Earnings; Calculation of the Simple Return Time and return on investment; The energy return time; Simple cumulative profit in cash flow; Subsidy and financial incentives; Inflation; Cost of Energy Improvement; Cost of kWh in cash flow; Concept of discount and calculation of the discount rate; Present value and acquired value; Updated Return Time; Net Present Value (NPV); Internal Rate of Return (IRR); Annual Gains in Constant Annuity (AGCA); Economized Fuel Cost (EFC); Cost of kWh in cash flow and discounted (LCE); Integration of externalities into energy costs; Case studies.

020GPRES2 Project Management 4 Cr.

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 purposes of this course are teaching students these successful techniques, and expose them to a variety of skills to manage the budget, schedule, and quality of projects that they are or will be responsible for.

020SFRES5 Refrigeration Systems 4 Cr.

Industrial refrigeration - The refrigeration cycle - Mollier diagram - Volumetric compression - The components of the refrigeration machine: Compressor - Heat exchangers - Refrigerant - The design of a cold room - External quantities: Thermostat - Internal quantities: Regulators - Safety equipment - Defrosting.
Prerequisite: HVAC 1 (020CL1ES3).

020ERMES5 Renewable Energy for Mechanical Engineering 4 Cr.

This course provides an overview of the latest technologies and developments in renewable energies, as well as the diversity of their applications. It aims to make students aware of the potentials and specificities of renewable energies in terms of electricity generation. What are these energy resources? How to capture and transform them? In what form they can be used? In this course are examined: The current state of renewable energies in the world and future prospects, Energy cycle on earth; Solar energy, availability conversion and applications of solar energy, thermal and photovoltaic systems; Wind power, availability, development and conversion methods; Hydroelectric power, conversion methods, types of hydraulic turbines; Biomass, sources, conversion methods; Geothermal energy, resource levels and system types.
The course also addresses energy storage technologies, including electrical batteries and pumped storage systems. In addition, a socio-economic and lifecycle analysis of renewable energy systems is provided.

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, actuator 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 will be presented. The principles of operation of various actuators will be discussed including pneumatic, magnetic, piezoelectric, linear, stepper, etc. Advanced feedback mechanisms will be implemented using software executing in an embedded system. The concepts for real-time processor programming will be also introduced. Image processing and artificial intelligence will be also presented in this course. Neural networks and advanced controllers will be shown along with their implementation using microcontrollers and/or software based (MATLAB, LabVIEW, etc.) and emphasized in this course.

020SPMES4 Selection and Properties of Materials 4 Cr.
This course explains the relation between the properties of the materials and the selection procedure during engineering applications. It starts by reviewing the relation between the structure and the properties of a material, the mechanical behavior showing the different types of deformation behavior, and the failure types including fracture, fatigue, creep, and corrosion. Then, it lists the different properties of engineering materials and details their graphical presentation. Finally, it introduces the strategy of selection following manual and computer-aided methods. It also studies the selection procedure for applications having multiple constraints and conflicting objectives and treats several examples of simple and multiple selection problems. This course discusses the importance of the material-shape relation during selection operation.
Prerequisite: Strength of Materials (020RDMES1) or Strength of Materials 1 (020RM1ES2).

020CEIES3 Sensors and Instrumentation 4 Cr.
This course includes 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).

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).

020RDMES1 Strength of Materials 6 Cr.
This course covers the phenomena related to a deformable solid subjected to a system of external loads. It explores the fundamental hypotheses of beam theory and elasticity,

geometric characteristics of sections, and types of stresses. Topics include generalized Hooke's law, axial stresses (mechanical, thermal stresses, and deformations), bending of beams and transverse shear (normal stresses, shear stresses, and displacements), and torsion of cylindrical members (stresses and deformations). The course also addresses bending moments and shear force diagrams, the state of stress in systems under combined loadings, and the analysis of stresses in the walls of thin-walled pressure vessels. Additionally, students will learn to calculate principal stresses, maximum in-plane shear stress, and absolute maximum shear stress. This course also introduces various static failure criteria for ductile and brittle materials. Practical applications include tensile tests on steel reinforcing bars, compressive tests on cylindrical concrete specimens, and twist tests on steel, brass, and copper specimens.
Prerequisite: Statics for Mechanical Engineering (020STMNI4 or 020STMCI4).

020MOTES4 Thermal Engines 4 Cr.
This course examines the fundamentals of the design and operation of internal combustion engines, focusing on fluid/thermal processes. The subjects covered include the analysis of the phenomena of aspiration, compression, combustion, expansion, expansion and formation of pollutants; heat transfer and friction phenomena; 2-stroke and 4-stroke engines, supercharges and performance characteristics; thermochemistry of air-fuel mixtures; social implications of motorization.
Prerequisites: General Chemistry (020CHGNI1 or 020CHGCI1), Thermodynamics: Laws and Applications (020TPAES1) or Thermodynamics: Principles and Phase Change (020TPPES1).

020TPAES1 Thermodynamics: Laws and Applications 6 Cr.
This course is designed to provide students with a comprehensive understanding of the foundational principles of thermodynamics and their practical applications in engineering systems. It integrates theoretical concepts with real-world scenarios, enabling students to apply thermodynamic principles to solve engineering problems and design efficient systems.
Prerequisite: Thermodynamics 1 (020TH1NI2 or 020TH1CI2).

020TRBES3 Turbomachines 4 Cr.
This course provides an overview of the latest technologies and developments in turbomachinery, as well as the diversity of their applications. It familiarizes students with the potential and specificities of the application of different turbomachines in the engineering world, from aviation to industrial machinery. In this course the following topics are covered: technology, operation, design and analysis of incompressible turbomachines such as centrifugal and axial flow pumps, impulse (Pelton) turbines and reaction turbines (Francis and Kaplan), as well as compressible flow turbomachines, such as: centrifugal and axial flow compressors, fans and blowers, axial and radial flow gas turbines, and steam turbines. Positive displacement pumps are also covered.

020RBMES4 Wheeled Robots 4 Cr.
This course provides in-depth coverage of wheeled mobile robots. The material covers (i) nonholonomy and integrability of kinematics constraints; (ii) modelling: kinematics,

dynamics, and state-space representation; (iii) nonlinear control strategies (open-loop and closed-loop), and (iv) simulation using the virtual wheeled mobile robots' laboratory. Four architectures are covered: differential-drive robot, Ackermann-based steering robot, Articulated-based steering robot, and mobile wheeled pendulum.

020WRNES1 Work Ready Now 2 Cr.

Personal Development - Communication Skills - Job Seeking Skills - Work Behaviors.

MASTER IN ELECTRICAL AND ELECTRONIC ENGINEERING

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program is Offered: CST

Objectives

The Master in Electrical and Electronic Engineering aims to train:

- Teachers and researchers
- High-level specialists in various relevant administrations and consultancy offices
- Foreign researchers: due to the importance of the issues addressed, opening up to foreign students from the Mediterranean basin can lead to a synergy favorable to a better common use of resources.

Program Learning Outcomes (Competencies)

1. Acquire and apply advanced knowledge appropriate to the discipline.
2. Solve critical issues and demonstrate expertise in key areas in the field of study.
3. Analyze, and think innovatively to develop novel solutions for real-world problems.
4. Apply new and diversified theoretical and experimental methods as appropriate to the discipline.
5. Integrate ethics and moral responsibility in engineering solutions in the field.
6. Conduct independent, original research and contribute to the advancement of knowledge in the field.
7. Communicate, at an advanced level, in oral and written form.
8. Recognize the importance of standards of professional integrity.

Admission Requirements

Candidates are selected based on their application file.

- Admission to the first semester of the Master's (M1) for candidates holding a Bachelor's degree in physics, electricity, electronics, electrical engineering, electromechanics, or an equivalent degree.
- Admission to the third semester of the Master's (M3) for electrical engineering graduates, holders of a “Maîtrise” or Master's degree in physics, electricity, electronics, electrical engineering, electromechanics.
- Admission to the third semester of the Master's (M3) for third-year electrical engineering students at ESIB (fifth year of higher education).

Courses/Credits Granted by Equivalence

Graduated engineers in electrical engineering, holders of a “Maîtrise” degree or a Master’s degree in physics, electricity, electronics, electrical engineering, electromechanics, students in the fifth year Electrical Engineering at ESIB, and holders of a recognized equivalent diploma can validate by equivalence a maximum of 60 credits of the program. Based on the proposal of the Director of the Department of PhD Studies, the admission jury will determine for each student admitted directly to M3, the courses and modules validated according to their curriculum and prior results, and will define their journey to the Master in the concentration concerned, possibly including additional prerequisites. The proposal for the validation of previous training is subject to the approval of the USJ Equivalence Commission.

Program Requirements

120 credits: Required Courses

Linear Control (4 Cr.). DC-DC Power Conversion (4 Cr.). Sensors and Instrumentation (4 Cr.). Mini Project 1 (6 Cr.). Electric Machines 2 (4 Cr.). Microprocessor Systems (4 Cr.). Digital Systems and Control (4 Cr.). English (4 Cr.) Power Systems Analysis (4 Cr.). DC-AC Power Conversion (4 Cr.). Modern Control (4 Cr.). Variable Speed Drives (6 Cr.). Mini Project 2 (8 Cr.). Digital Systems Architecture (4 Cr.). Case Study of Machines Advanced Control (2 Cr.). Case Study of Advanced Power Electronics (2 Cr.). Advanced Control of Electrical Machines (4 Cr.). Advanced Power Electronics (4 Cr.). Modeling and Control of Static Converters (4 Cr.). Electric Networks with Distributed Sources (4 Cr.). Energy Storage (4 Cr.). Case Study of Advanced Control Techniques (2 Cr.). Research Project with Thesis (30 Cr.).

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020AULMM1	Linear Control	4
020CCCMM1	DC-DC Power Conversion	4
020CEIMM1	Sensors and Instrumentation	4
020GE1MM1	Mini Project 1: validated by equivalence for ESIB students	6
020ME2MM1	Electric Machines 2	4
020SCNMM1	Digital Systems and Control	4
020SMPMM1	Microprocessor Systems	4
	Total	**30**

Semester 2

Code	Course Name	Credits
020ANGMM2	English	4
020ANRMM2	Power Systems Analysis	4
020CCAMM2	DC-AC Power Conversion	4
020CTMMM2	Modern Control	4
020EVVMM2	Variable Speed Drives	6
020GE2MM2	Mini Project 2: validated by equivalence for ESIB students	8
	Total	**30**

Semester 3

Code	Course Name	Credits
020ASNMM3	Digital Systems Architecture	4
020BCMMM3	Case Study of Electrical Machines Advanced Control	2
020BEPMM3	Case Study of Advanced Power Electronics	2
020CAEMM3	Advanced Control of Electrical Machines	4
020EPAMM3	Advanced Power Electronics	4
020MCCMM3	Modeling and Control of Static Converters	4
020RSDMM3	Electric Networks with Distributed Sources	4
020STEMM3	Energy Storage	4
020BCAMM3	Case Study of Advanced Control Techniques	2
	Total	**30**

Semester 4

Code	Course Name	Credits
020MGEMM4	Research Project with Thesis	30
	Total	**30**

Course description

Semester MR1

020AULMM1 Linear Control 4 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. 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, as well as a set of lab experiments leading to the design and test of a linear control system.

020CCCMM1 DC-DC Power Conversion 4 Cr.

This course presents different topologies of DC-DC switch-mode power converters. It studies two categories of converters: the choppers for DC-motor drives and the DC power supplies. A detailed analysis starting from the possible configurations, then finding the mathematical equations, the waveforms and the input-output features, and the selection of the semiconductor devices and all other components is elaborated for each topology. Rating criteria based on the evaluation of the voltage and current stresses are elaborated.

020CEIMM1 Sensors and Instrumentation 4 Cr.

A sensor is, by definition, a system that converts a signal that is generally non-electric in nature (temperature, luminous flux, velocity, position, displacement, force, weight, torque, etc.) into an electrical signal that is easily processed. Sensors are generally used in monitoring, measurement or control systems. The course begins with a general review of the main characteristics of a sensor (sensitivity, time response delay, measurement errors). Then, several types of sensors, such as optical sensors, temperature sensors, tachometric sensors, position and displacement sensors, and force, weight and torque sensors, are described and studied individually in detail.

020GE1MM1 Mini Project 1 **6 Cr.**
Students will carry out a mini project in one of the courses of the semester MR1.

020ME2MM1 Electric Machines 2 **4 Cr.**
This course aims to extend the concepts of electrical engineering according to four axes: I) Transformers: Special transformers – Transformers in unbalanced mode – Transformers in transient mode – Parallel operation of transformers. II) DC machines: DC machines in transient mode - Application in unsaturated transient conditions. III) Induction Machines (IM): Generator and brake operation of a three-phase IM - Special types of IM: Deep-Bar Squirrel-Cage, Double-Cage rotors and Single-Phase IM – Modeling of the induction machine in transient mode and applications. IV) Synchronous machines: Rotating fields theory – Transient modeling of synchronous machines: with smooth poles, with salient poles, with or without damper bars – Applications.

020MPMM1 Microprocessor Systems **4 Cr.**
Topics covered include: Difference between microprocessors, microcontrollers and DSP – microprocessor architecture ; realization of a basic board – Microcontroller architecture (PIC 18F2520) – Implementation of ROM, RAM and DATA EEPROM memory – special registers – addressing modes – inputs/outputs – interrupts – timers – analog to digital converter – asynchronous serial port – read from program memory – comparators – watchdog – sleep mode – Low Voltage Detect – oscillator – configuration words – Design, simulation and realization of microprocessor systems.

020SCNMM1 Digital Systems and Control **4 Cr.**
This course is divided into three main parts. The first part discusses discrete system modeling, z-transform, discrete transfer functions and discrete systems stability. The second part develops the design of digital controllers (discretized classic controllers, dead-beat control). The final part presents the implementation of digital controllers using embedded systems and real time simulations of a system in closed loop.

<u>Semester MR2</u>

020ANGMM2 English **4 Cr.**
This course is designed to develop critical thinking, reading, oral and writing skills. It focuses on synthesizing sources producing a research paper and defending it in front of an audience. Emphasis is on the analytical reading of different text types required in the courses as well as

on synthesis from a variety of sources to produce a written text and present it orally.

020ANRMM2 Power Systems Analysis 4 Cr.
This course introduces the students to the physical aspects of the electric transmission lines. It shows how to determine their equivalent mathematical model and calculate their structural parameters. Based on such model, performance study is elaborated in both permanent and transient regimes (power losses, voltage regulation, power factor, transient overvoltage). Compensation techniques to improve the power factor are presented. Numerical methods and algorithms for calculating the power flow are also explained and applied. Short-circuit analysis is detailed, and power system stability following short-circuit disturbance is discussed. In addition, methods for the selection of isolators and protection devices are exposed. Finally, the benefits of DC transmission systems and its technical aspect are presented.

020CCAMM2 DC-AC Power Conversion 4 Cr.
This course presents different topologies of DC-AC switch-mode power converters: single and three-phase inverters, two and multilevel structures. A detailed analysis starting from the possible configurations, then the establishment of the mathematical equations, the waveforms and the input-output features, and the selection of the semiconductor devices and all other components is elaborated for each topology. Rating criteria based on the evaluation of the voltage and current stresses are elaborated.
In addition, this course introduces and studies different Pulse-Width-Modulation (PWM) control strategies: carrier-based PWM, space-vector modulation, pre-calculated modulation, sigma-delta and delta modulations. Numerical simulations are performed to verify the theoretical concepts.

020CTMMM2 Modern Control 4 Cr.
Topics covered include: Modeling a multi-variable system, interpretation, and linearization. Response and matrix transfer. Realization in controllability, observability, and Jordan forms. Controllability, and its properties, partial controllability. Observability and its criteria. Minimum implementation, stabilization, and detection. Directions of the poles and zeros, simplification. Pole placement control, error integration, and observers. Optimal quadratic control (LQG): introduction, Riccati equation, Kalman filter, validity conditions. Guided mini project: modeling, design, and simulation.

020EVVMM2 Variable Speed Drives 6 Cr.
This course aims to introduce the multiple control possibilities offered by variable speed drives for the three main types of motors in the electrical engineering field. I) Variable speed DC machine: Four-quadrant operation, Four-quadrant three-phase rectifier with no circulating current, Speed control using cascaded loops, Current loop and speed loop. II) Variable speed induction machine: Steady-state equivalent circuit at high frequencies, Torque harmonics, Scalar control of a squirrel-cage induction machine, Vector control of a squirrel-cage induction machine, introduction to DTC control of an induction machine. III) Variable speed synchronous drives: introduction to the scalar control and the vector control of synchronous drives. All three case studies are simulated and validated using MATLAB/Simulink software.

020GE2MM2 Mini Project 2 8 Cr.
Students will carry out a mini project in one of the courses of the semester MR2.

Semester MR3

020ASNMM3 Digital Systems Architecture 4 Cr.
Topics covered include: Introduction to FPGAs and synthesizable VHDL. State machines. Applications. Algorithm-Architecture Adequation Method.

020BCMMM3 Case Study of Electrical Machines Advanced Control 2 Cr.
Case study: Energy conversion chain design for a variable speed drive.
This case study focuses on designing an energy conversion chain, which includes a variable speed drive for a mechanical load. The requirements involve selecting the appropriate motor, associated converter(s), and the most suitable control method for the application. The complete sizing of the chain is validated through simulations to ensure the system operates correctly. The study also explores the application of predictive control to a permanent magnet synchronous drive, followed by a performance comparison with a conventional control method based on PI regulators.

020BEPMM3 Case Study of Advanced Power Electronics 2 Cr.
Case study on design, control, simulation and performance analysis of a high-power quality converter.

020CAEMM3 Advanced Control of Electrical Machines 4 Cr.
Topics covered include: Vector control of asynchronous actuators. Direct Torque Control (DTC). Sensorless control. Estimation and observation of unmeasurable variables. Design of controllers and observers. Self-control and vector control of synchronous actuators. Digital implementation: ADC, sensors, delays, filters, etc. Control of speed and position.

020EPAMM3 Advanced Power Electronics 4 Cr.
Topics covered include: Harmonic distortion in electric grids. Active compensation. Modeling and control of switch-mode power converters. Power factor correction circuits. Case of a Boost, a SEPIC and a Sheppard-Taylor converter. High power factor three-phase rectifiers. Six-switch rectifier. Vienna rectifier. Current injection rectifiers. Active and hybrid power filters.

020MCCMM3 Modeling and Control of Static Converters 4 Cr.
Topics covered include: Instant modeling and average values, sampled models. PWM and amplitude control of static converters, case of three -phase tension inverters. Comparisons of different modulation laws. Control laws for single -phase and three-phase PWM recovery in sinusoidal absorption (3 axes, 2 axes, DPC, etc.). Control of active parallel filters (control of the reactive power and harmonics). Predictive control laws for converters: Application to DC-DC and AC-DC converters.
Case study – Control of a PFC as part of a cascade structure using MATLAB/Simulink.

020RSDMM3 Electric Networks with Distributed Sources 4 Cr.
Topics covered include: Distributed generation: definition, benefits, smart grids, role of power electronics, energy storage. Static converters in distributed networks: families of converters, applications, power semiconductors. Grid-connectivity of photovoltaic sources. Grid-connectivity of wind generation systems. Control and modulation techniques. Power quality and filters. Static compensators and FACTS. Numerical methods for power flow analysis. Transient stability.

020STEMM3 Energy Storage 4 Cr.
Topics covered include: Energy storage issues, electrical energy as a vector. Electricity: Easy transport but problematic storage. Values range (mass and volume powers) - Application contexts (stationary and vehicles). Stationary storage (cases, interest, challenges) - Available technologies. Primary sources (batteries). Accumulators (electrochemicals, electromagnetic, mechanical. Performance, question of technology but also management.
Case study I: Production/consumption adequacy in a home (islanding). Production fluctuations (wind, solar). Consumption fluctuations. Hourly production/consumption and storage inadequacy.
Case study II: Optimization of an airplane network (power supply to a landing gear). Structure of a plane edge network. Some values range (powers involved, voltages, currents, size, etc.). Optimization of on-board weight (local storage vs cables section). Power structure around an electric actuator landing gear. System control.
Case study III: The battery pack in a vehicle (BMS, load balancing, etc.). Batteries for electric vehicles (advantages and disadvantages). Energy gauge: a necessity and a serious problem according to technology. The battery: a complex component to model. Modeling, characterization and identification in real time - Battery packs, characteristics dispersion and cell balancing. Global structure for managing a battery pack: BMS - The life of a battery and its indicators. Towards the fast load: issues and difficulties.

020BCAMM3 Case Study of Advanced Control Techniques 2 Cr.
Topics covered include: Quadratic controls. Predictive control. Application of predictive control to a 2nd order system.

<u>Semester MR4</u>

020MGEMM4 Research Project with Thesis 30 Cr.
This course serves as an initiation into research techniques. It is the synthesis of fourth months of research work in a research centre or laboratory.

MASTER IN ROAD SAFETY MANAGEMENT (MANSER)

Main Language of Instruction:

French: ◙	English: ◙	Arabic: ◙

Campus Where the Program Is Offered: CST

Objectives

The Master in Road Safety Management (MANSER) aims to train students capable of the following:

- Mastering real multidisciplinary expertise in the field of road safety management and being called upon to work in national, international and specialized organizations.
- Possessing the capacity to implement a policy of actions aimed at tackling the root causes of road insecurity.
- Pursuing higher education.

Program Learning Outcomes (Competencies)

1) Identify, formulate and resolve complex problems around road safety by applying the principles of engineering, psychology, economics and communication.
2) Analyze road risks and implement strategies to mitigate them.
3) Manage traffic by mastering the planning and implementation of efficient traffic systems to improve fluidity and road safety.
4) Identify emerging technologies such as driver assistance systems, intelligent signaling, etc.
5) Formulate and implement regulations related to road safety to effectively enforce them.
6) Plan, coordinate and implement initiatives to improve road safety.
7) Analyze and evaluate public policies and offer recommendations to reinforce road safety.
8) Develop campaigns to educate drivers, pedestrians and cyclists on road safety.
9) Identify and prepare answers to emergency situations on the roads, such as major accidents.
10) Include sustainable practices into road safety planning and management.

Admission Requirements

Candidates are selected following the study of the file provided by the student.

- Admission to the first semester of the Master for engineering graduates and Master 1 holders.

Courses/Credits Granted by Equivalence

Students recruited for this Master should all have at least a Baccalaureate+4. Therefore, 60 credits are granted by equivalence, which translates to the equivalence of the first year of Master.

Program Requirements

120 credits: Required courses (60 credits), Courses granted by equivalence (60 credits)

Required Courses (60 Cr.)
Behavior of Road Users (2 Cr.)
Economics of Road Safety (2 Cr.)
Road Environment and Traffic Management (2 Cr.)
Epidemiology and Statistics Applied to Road Safety (2 Cr.)
Management of Transport Fleet (2 Cr.)
Management of Road Accident Scenes (2 Cr.)
Introduction to Intelligent Transport Systems, New Generation of Vehicles and Road Safety (2 Cr.)
Laws, Codes and Roles of Road Safety Forces (2 Cr.)
Research Dissertation on Road Safety (30 Cr.)
Mobility and Road Safety in Urban Areas (2 Cr.)
Road Safety Policy and Plans (2 Cr.)
Road Safety Integration Seminar (2 Cr.)
Road Safety Practical Internship (2 Cr.)
ISO 39001 Vehicle Safety and Road Safety Management System (2 Cr.)
Information Systems - Database (2 Cr.)
Communication Techniques and Road Safety Awareness (2 Cr.)

Suggested Study Plan

Semester 1

Code	**Course Name**	**Credits**
433SR71M1	Behavior of Road Users	2
433SR73M1	Road Environment and Traffic Management	2
433SR72M1	Epidemiology and Statistics Applied to Road Safety	2
433SR76M1	Management of Transport Fleet	2
433SR77M1	Management of Road Accident Scenes	2
433SR74M1	Introduction to Intelligent Transport Systems, New Generation of Vehicles and Road Safety	2
433SR80M1	Laws, Codes and Roles of Road Safety Forces	2
433SR79M1	Mobility and Road Safety in Urban Areas	2
433SR75M1	Road Safety Policy and Plans	2
433SR81M1	ISO 39001 Vehicle Safety and Road Safety Management System	2
433SR22M2	Information Systems - Database	2
433SR70M1	Communication Techniques and Road Safety Awareness	2
	Total	**24**

Semester 2

Code	**Course Name**	**Credits**
433SR82M2	Economics of Road Safety	2

433SR85M2	Research Dissertation on Road Safety	30
433SR26M2	Road Safety Integration Seminar	2
433SR98M2	Road Safety Practical Internship	2
	Total	**36**

Course description

433SR71M1 Behavior of Road Users 2 Cr.
This course covers the principles and practices of psychology. It aims to study the different facets of the behavior of individuals on the roads, with emphasis on road safety, regulations and psychological factors. The course studies the psychological variables linked to the behavior of road users and the performance of vehicle drivers.

433SR73M1 Road Environment and Traffic Management 2 Cr.
This course presents the components of the road environment and their impact on traffic. It analyzes the basic principles of traffic management and road infrastructure planning, examines technological innovations related to traffic management, assesses environmental and societal factors influencing road design, and explains the application of modeling techniques to predict and improve road traffic.

433SR72M1 Epidemiology and Statistics Applied to Road Safety 2 Cr.
This course defines epidemiological concepts applied to road safety, including incidence, prevalence and health determinants. It explains and trains in the collection and analysis of statistical data from sources such as accident reports, field surveys and government databases. The course also analyzes road safety epidemiological patterns to assess risk factors, analyze temporal and spatial trends, and understand patterns of road accident injuries.

433SR76M1 Management of Transport Fleet 2 Cr.
This course aims to develop skills for implementing plans and programs in order to manage the safety of transport fleets involving all the components concerned. This discipline covers route planning, vehicle maintenance, driver management and the monitoring of associated costs.

433SR77M1 Management of Road Accident Scenes 2 Cr.
This course aims to explore the management of road accident scenes by examining the protocols, best practices and skills needed to ensure effective intervention in these critical situations.

433SR74M1 Introduction to Intelligent Transport Systems, New Generation of Vehicles and Road Safety 2 Cr.
The objective of this course is to introduce students to the fundamental concepts of intelligent transport systems, new generation of vehicles and their impact on road safety.

433SR80M1 Laws, Codes and Roles of Road Safety Forces 2 Cr.

This course aims to provide an in-depth understanding of the laws, codes and essential roles of road safety forces, which are fundamental elements in ensuring safety on the roads. The goal is to gain a complete perspective on how road safety forces contribute to traffic management, accident prevention and enforcement of driving rules.

433SR79M1 Mobility and Road Safety in Urban Areas 2 Cr.

This course aims to explore the dynamics of mobility and road safety in the urban areas. With a focus on specific challenges encountered in urban environments, students will gain rigorous knowledge on traffic management strategies, infrastructure design and the best practices to ensure efficient and safe mobility in urban environments.

433SR75M1 Road Safety Policy and Plans 2 Cr.

This course aims to take an in-depth look at policies and plans related to road safety. Focusing on government initiatives and long-term strategies, the objective of this course is to gain a thorough understanding of road safety policies and action plans aimed at reducing accidents, promoting responsible driving and improving infrastructure.

433SR81M1 ISO 39001 Vehicle Safety and Road Safety Management System 2 Cr.

This course focuses on the practical application of the ISO 39001 standard relating to road safety management systems. The objective is to explore the principles, methods and best practices for establishing an effective vehicle safety management system, by highlighting the prevention of accidents, the reduction of risks and the promotion of road safety.

433SR22M2 Information Systems - Database 2 Cr.

The objective of this course is to introduce the fundamental principles of information systems with particular emphasis on the design, management and use of databases. Students will explore theoretical concepts and practical applications of databases in the context of modern information systems.

433SR70M1 Communication Techniques and Road Safety Awareness 2 Cr.

The objective of this course is to explore communication techniques in order to increase awareness of and promote road safety. Students will gain practical skills in designing and implementing awareness campaigns, communicating key messages and mobilizing the community to encourage responsible behavior on the road.

433SR82M2 Economics of Road Safety 2 Cr.

The objective of this course is to explore the economic aspects of road safety, with emphasis on accident cost analysis, investments in prevention, and economic strategies aimed at improving road safety. Students will gain an in-depth understanding of the financial implications of road safety and the economic approaches to reduce crashes.

433SR85M2 Research Dissertation on Road Safety 30 Cr.

Application of research and dissertation writing approaches and methods.

433SR26M2 Road Safety Integration Seminar 2 Cr.

The road safety integration seminar aims to bring together students around key themes in the field, thus promoting a thorough understanding of the issues, best practices and current challenges in road safety. It also offers a platform for exchange, collaboration and networking between actors involved in this field.

433SR98M2 Road Safety Practical Internship 2 Cr.

The road safety practical internship aims to allow students to apply the theoretical knowledge acquired during their training in a real road safety environment. Interns will have the opportunity to work on concrete projects, collaborate with professionals in the sector and gain a significant practical experience in the road safety field.

MASTER IN RENEWABLE ENERGY

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The Master in Renewable Energy aims to train researchers and engineers in energy efficiency and renewable energy. The program aims to train specialists and experts who can design and implement high-efficiency energy systems powered by renewable sources. Graduates will be prepared to lead innovative projects in this field, whether in academic research or within cutting-edge technology centers and industrial sectors at local and regional levels. Additionally, the program supports students interested in pursuing PhD studies in renewable energy. Through this program, students will gain a comprehensive understanding of global energy challenges, the depletion of fossil fuels, climate change, and pollution, as well as the diverse forms of renewable energy and their practical applications.

Program Learning Outcomes (Competencies)

Graduates will be able to:

1. Acquire and apply advanced knowledge appropriate to the discipline.
2. Solve critical issues and demonstrate expertise in key areas in the field of study.
3. Analyze and think innovatively to develop novel solutions for real-world problems.
4. Apply new and diversified theoretical and experimental methods as appropriate to the discipline.
5. Integrate ethics and moral responsibility in engineering solutions in the field.
6. Conduct independent, original research and contribute to the advancement of knowledge in the field.
7. Communicate, at an advanced level, in oral and written form.
8. Recognize the importance of standards of professional integrity.

Admission Requirements

Candidates are selected based on the review of their application file:

- Admission to the third semester of the Master's program (M3) is available for candidates holding an engineering degree in Electrical, Mechanical, Civil, Chemical, or Petrochemical Engineering.

Courses/Credits Granted by Equivalence

The content of the MR1 and MR2 semesters (which accounts for 60 Credits) includes prerequisite courses for MR3, which are equivalent to a bachelor degree in Electrical, Mechanical, Civil, Chemical, and Petrochemical Engineering.

Program Requirements

The Master's program comprises 120 credits, spread over 4 semesters: MR1, MR2 (as prerequisites corresponding to the 5th year of engineering), MR3, and MR4, with 30 credits each.

This program provides instruction for the MR3 and MR4 semesters, including:

- Theoretical and practical courses.
- A research internship at an accredited center, culminating in the writing of a thesis.

Required Courses (54 Cr.)

Energy Efficiency (3 Cr.). Wind Energy (3 Cr.). Hydropower (3 Cr.). Solar Energy (4 Cr.). Biomass Energy (3 Cr.). Energy Storage (3 Cr.). Renewable Energy Project Evaluation (3 Cr.). Renewable Energy Seminars (2 Cr.). Research Internship with Thesis (30 Cr.).

Institution’s Elective Courses (6 Cr.)

Two courses to choose from the following list:
Distributed Generation Systems (3 Cr.). Advanced Power Electronics (3 Cr.). Thermal and Thermodynamic Conversion Systems (3 Cr.). Modeling and Optimization of Thermal Systems (3 Cr.). Low-Energy Green Buildings (3 Cr.). Smart Electrical Grids (3 Cr.). Recyclable Materials in Construction (3 Cr.).

Suggested Study Plan

Semester 1

Code	**Course Name**	**Credits**
MRER00M3	Energy Efficiency	3
MRER01M3	Wind Energy	3
MRER02M3	Hydropower	3
MRER03M3	Solar Energy	4
MRER04M3	Biomass Energy	3
MRER05M3	Energy Storage	3
MRER06M3	Renewable Energy Project Evaluation	3
MRER07M3	Renewable Energy Seminars	2
	Institution’s Elective Courses	6
	Total	30

Semester 2

Code	**Course Name**	**Credits**
MRER00M4	Research Internship with Thesis	30
	Total	**30**

Course description

MRER09M3 Advanced Power Electronics 3 Cr.
This course explores advanced topics in power electronics, focusing on modern converter technologies and their applications. Multi-level converters with clamping diodes and floating capacitors. Matrix structures. Non-polluting converters. Direct current transportation. Active and hybrid filtering. Modeling and control.Prerequisite: None

MRER04M3 Biomass Energy 3 Cr.
This course provides a comprehensive introduction to biomass energy and its applications. Topics include the fundamental concepts of bioenergy, classification and types of biomass, management of urban solid waste, dry and wet residual biomass treatment, and direct incineration processes. The course also covers the use of photo-bioreactors, the biochemistry behind biomass transformation, methanization processes, and the production and utilization of various biofuels.
Prerequisite: None

MRER08M3 Distributed Generation Systems 3 Cr.
This course focuses on the analysis and management of electrical networks. Topics include energy generation in isolated systems. Distributed energy generation. Smart electrical grids. Modelling and optimization techniques.
Prerequisite: None

MRER00M3 Energy Efficiency 3 Cr.
This course examines the key aspects of energy efficiency within the broader global energy context. Topics include the status of energy reserves, environmental impacts, legal frameworks, international protocols and agreements, and energy consumption across various sectors. The course also explores passive energy-saving measures, the use of high-efficiency equipment, advanced energy conversion methods and the influence of user behavior on the demand.
Prerequisite: None

MRER05M3 Energy Storage 3 Cr.
This course covers the principles and technologies electrical, mechanical, or thermal conversion systems. The operation of electrical generators, and the static conversion of electrical energy. A significant focus is placed on storage systems: batteries, accumulators, supercapacitors, modelling and control, numerical simulations.
Prerequisite: None

MRER02M3 Hydropower 3 Cr.
This course provides an in-depth study of hydropower systems and technologies. Topics include the fundamentals of hydraulic mechanics, the design and operation of hydraulic turbines, the structure and functioning of hydroelectric power plants, as well as the role of dams and pipelines. The course also addresses the impact of rainfall variability on hydropower generation.
Prerequisite: None

MRER12M3 Low-Energy Green Buildings 3 Cr.

This course explores sustainable building design and its environmental impact. Topics include initiatives in eco-friendly building design. Environmental impact of construction materials. Environmental impact of construction, demolition, and renovation. CO2 emissions assessment. Integration of sustainable and passive principles in building architectural design. Solar geometry. Climate/regional limitations. Natural lighting. Passive design. Natural ventilation and infiltration. Insulation. Energy storage materials. Bioclimatic concept. Case studies.

Prerequisite: None

MRER11M3 Modelling and Optimization of Thermal Systems 3 Cr.

This course focuses on the modeling and analysis of renewable energy thermal systems. Topics include : Renewable energy thermal systems. Phenomenological laws and conservation principles. General modelling approach. Modelling of thermal phenomena. Spatial discretization methods. Temporal resolution methods. Dynamic simulation. Inverse methods. Optimization methods.

Prerequisite: None

MRER16M3 Recyclable Materials in Construction 3 Cr.

The construction industry is a significant waste-producing industry and, as a result of its inherent size, may have many opportunities for on-site recycling, without transportation costs, providing good environmental solutions for waste management. This course covers fundamental individual construction materials as well as the process of transforming by-products and waste into new construction materials.

Prerequisite: None

MRER06M3 Renewable Energy Project Evaluation 3 Cr.

This course covers the key aspects of evaluating energy generation systems, including cost analysis, feasibility studies, and assessments of reliability and maintainability. It also addresses the environmental impacts of energy systems and emphasizes life cycle analysis to evaluate sustainability.

Prerequisite: None

MRER07M3 Renewable Energy Seminars 2 Cr.

This course involves a series of lectures on subjects and themes related to renewable energies: fuel cells (fuel cell electrochemistry, types and technologies, hydrogen production and storage, transportation, commercialization and applications, hybrid vehicles), geothermal (thermodynamics and fluid dynamics, geothermal fluids, geological exploration techniques, geophysical and geochemical, geothermal power plants), Green hydrogen (its production from renewable sources, its various applications in industry and transportation, as well as its environmental impact).

Prerequisite: None

MRER00M4 Research Thesis 30 Cr.

This course serves as an initiation into research techniques. It is the synthesis of six months of research work in a research centre or laboratory.

Prerequisite: None

MRER14M3 Smart Electrical Grids 3 Cr.

This course explores the ecosystem of smart electrical grids, focusing on both conventional and renewable energy production. Topics include the quality and efficiency of electricity transmission, as well as the protection, automation, and control of electrical grids. The course also covers the management and global control of energy systems, distributed electricity storage, active building management. Consumer management and consumer behaviour in the residential sector. Additionally, it examines the integration of electric vehicles and the role of standardization, regulatory modification, and incentives for the development of smart electrical grids.Prerequisite: None

MRER03M3 Solar Energy 4 Cr.

This course examines a comprehensive study of solar energy systems, covering solar radiation and resource assessment in depth. Topics include the precise calculation of solar energy contributions and their distribution within receiving systems. The course explores both thermal solar systems and their applications, as well as photovoltaic systems and their integration into modern energy systems. Students will also investigate hybrid systems that combine thermal and photovoltaic technologies, with a focus on optimization and real-world applications in energy generation.

Prerequisite: None

MRER10M3 Thermal and Thermodynamic Conversion Systems 3 Cr.

This course explores thermal and thermodynamic conversion systems. Topics include the concept of exergy and its application in exergy analysis, various engine cycles, and cogeneration systems. The course covers refrigeration cycles, heat pumps, fluid networks, and heat exchangers, with a focus on the Pinch method for energy optimization. Additionally, students will study the application of these principles to renewable energy systems, enhancing their understanding of energy conversion processes in sustainable technologies.

Prerequisite: None

MRER01M3 Wind Energy 3 Cr.

This course provides a comprehensive study of wind energy systems, focusing on the aerodynamics of wind turbines and their design principles. Topics include electromechanical conversion systems, control mechanisms, and methods for resource assessment. Additionally, the course covers the feasibility of wind energy projects and explores various application areas, equipping students with the knowledge to evaluate and implement wind energy solutions.Prerequisite: None

MASTER IN WATER SCIENCES

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The management and renewal of water resources, along with maintaining their quality, efficient use, and the interplay between water and human health, are governed by a variety of mechanical, physico-chemical, or biological processes. These processes are crucial for managing the movement and quality of water and the substances it carries. In today's world, it's increasingly vital to possess a quantitative understanding of these processes to create advanced scientific tools. These tools are designed to forecast the future state of these resources at different spatial and temporal scales and to manage human impact on the hydrological cycle. Significant investments in both fundamental and applied research are essential and must be initiated. The Saint Joseph University of Beirut, recognizing the significance of these challenges, has established a Center focused on the scientific study of these issues. To support the research efforts of this Center, a postgraduate program has been introduced, offering a master's degree titled 'Water Sciences,' aimed at educating:

- Instructors and researchers.
- High-level experts, essential for various governmental departments and consulting firms.
- International researchers: Given the significance of the issues at hand, welcoming students from across the Mediterranean basin could foster a beneficial synergy for the collective management and utilization of water resources.

Program Learning Outcomes (Competencies)

The developed skills encompass the entire hydrological cycle, from understanding the physical and chemical processes to implementing water treatment methods. Students are trained to tackle complex challenges related to the sustainable management of water resources, both locally and internationally. Furthermore, research projects and mini-projects help to hone their ability to apply these skills in real-world contexts. At the end of the program, graduates are prepared to take on leadership roles as educators, researchers, specialists, and key contributors in administrations and design offices dedicated to the preservation and rational use of water resources.

Admission Requirements

Candidates are selected following the review of their application file:
Admission to the first semester of the Master's program (M1) is for graduates in Civil and Environmental Engineering or holders of a Bachelor in Water and Environment.

- Admission to the third semester of the Master’s program (M3) is for graduates in Civil or Environmental Engineering, fifth-year civil engineering students at ESIB, and holders of an equivalent recognized diploma.

Courses/Credits Granted by Equivalence

Civil engineers graduating from ESIB, holders of a Master’s or a Research Master’s in water sciences, fifth-year civil engineering students at ESIB, and holders of an equivalent recognized diploma, validate by equivalence 60 credits of the program:
Hydraulics (6 Cr.). Hydrology (4 Cr.). Statistical Hydrology (4 Cr.). Measurement and Data Acquisition (4 Cr.). Water and Wastewater Treatment (4 Cr.). Solid Waste Management (4 Cr.). Mini Project 1 (4 Cr.). Strength of Materials (7 Cr.). Fluid Mechanics (7 Cr.). Soil and Rock Mechanics (8 Cr.). Finite Elements (4 Cr.). Mini Project 2 (4 Cr.).

Program Requirements

This Master’s program consists of 120 credits, distributed over 4 semesters MR1, MR2, MR3, and MR4, with generally 30 credits each. The Master’s preparation includes:

- Theoretical and practical courses.
- Specialized seminars and conferences.
- Technical visits.
- A research internship in an approved center on a thesis topic.

Required courses (120 credits)
Spatial and Temporal Series Analysis (3 Cr.). Biogeochemistry (3 Cr.). Solid Waste Management (4 Cr.). Finite Elements (4 Cr.). Physico-Chemical Equilibria (3 Cr.). Water and Wastewater Treatment (4 Cr.). Water Management: Theory and Models. Water Resources. Urban Water (3 Cr.). Hydraulics (6 Cr.). Hydrology (4 Cr.). Physical Hydrology (3 Cr.). Statistical Hydrology (4 Cr.). Karst (3 Cr.). Underground Reservoirs (3 Cr.). Fluid Mechanics (7 Cr.). Soil and Rock Mechanics (8 Cr.). Measurement and Data Acquisition (4 Cr.). Mini Project 1 (4 Cr.). Mini Project 2 (4 Cr.). Advanced Processes for Wastewater Treatment (3 Cr.). Surface Water Quality (3 Cr.). Strength of Materials (7 Cr.). Research Internship with Thesis (30 Cr.). Climate Variability (3 Cr.).

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020HYDMM1	Hydraulics	6
020HYOMM1	Hydrology	4
020HSTMM1	Statistical Hydrology	4
020ACQMM1	Measurement and Data Acquisition	4
020TRAMM1	Water and Wastewater Treatment	4
020DECMM1	Solid Waste Management	4
020SE1MM1	Mini-Project 1	4

	Total	**30**

Semester 2

Code	**Course Name**	**Credits**
020RDMMM2	Strength of Materials	7
020MEFMM2	Fluid Mechanics	7
020MESMM2	Soil and Rock Mechanics	8
020ELFMM2	Finite Elements	4
020SE2MM2	Mini-Project 2	4
	Total	**30**

Semester 3

Code	**Course Name**	**Credits**
020ASTMM3	Spatial and Temporal Series Analysis	3
020BGCMM3	Biogochemistry	3
020EPCMM3	Physico-Chemical Equilibria	3
020CFTMM3	Water Management: Theory and Models. Water Resources. Urban Water	3
020HYPMM3	Physical Hydrology	3
020KARMM3	Karst	3
020RESMM3	Underground Reservoirs	3
020TEUMM3	Advanced Processes for Wastewater Treatment	3
020QESMM3	Surface Water Quality	3
020VCLMM3	Climate Variability	3
	Total	**30**

Semester 4

Code	**Course Name**	**Credits**
020MSEMM4	Research Internship with Thesis	30
	Total	**30**

Course description

020TEUMM3 Advanced Processes for Wastewater Treatment 3 Cr.

Topics covered include: Conventional wastewater treatment processes: Review - Sizing of conventional physicochemical treatment processes - Sizing of conventional biological treatment processes - Advanced physicochemical treatment processes. Advanced biological treatment processes (new anaerobic and aerobic membrane techniques). Tertiary treatment processes (case of industrial effluents). Techno-economic study of the installation of wastewater treatment units. Evaluation of the conditions, advantages, and constraints of installing wastewater treatment units. Research and case studies of cutting-edge technologies.

Prerequisites: none

020BGCMM3 Biogeochemistry **3 Cr.**
Topics covered include: Subterranean transfers. Isotopic tracing of natural waters. Major natural cycles (C, N, S, P, O)
Prerequisites: none

020VCLMM3 Climate Variability **3 Cr.**
Topics covered include: Climate variability, impact on hydrology.
Prerequisites: none

020ACQMM1 Data Measurement and Acquisition **4 Cr.**
Topics covered include: Equipment. Speed measurement at laboratory and industrial scales. Potable and hot water meters. Equipment for modern network management. Basics of sensors, remote transmission, and remote control. Surface hydrological measurements. Climatic stations, evaporation. Limnometry. Flow measurement. Calibration of a hydrometric station. Data acquisition and processing.
Prerequisites: none

020ELFMM2 Finite Elements **4 Cr.**
Topics covered include: Fundamentals of the finite element method. Variational formulation. Discretization. Assembly of elementary equations and global analysis. Numerical methods.
Prerequisites: none

020MEFMM2 Fluid Mechanics **7 Cr.**
Topics covered include: Concepts and properties of fluids. General principles of kinematics. Stress theory. Statics of incompressible and compressible fluids. Balance equations. Application to perfect fluids. Vortical kinematics. Potential plane flows. Flow regimes and application to laminar and turbulent flows. Introduction to the boundary layer. Dimensional analysis and similarity. Numerical approach. Practical Work (TP): Nozzles - Rheoelectric analogy flows. Poiseuille flows. Verification of Bernoulli’s relation. Flow in a hydrodynamic tunnel. Viscosity. Analysis of jets on plates and study of flow regimes.
Prerequisites: none

020HYDMM1 Hydraulics **6 Cr.**
Topics covered include: Boundary layer. Head loss. Pressurized networks in steady and unsteady state. Turbopumps. Transient regime networks. Network protection. Basic concepts of turbines. Feasibility calculations. Open channels. Numerical approach. Practical Work (TP): Turbopumps. Head loss. Flows in open channels. Transient flows under pressure. Permeability study.
Prerequisites: none

020HYOMM1 Hydrology **4 Cr.**
Topics covered include: Basic climatological phenomena. Energy independence in a building from solar contributions. Study elements for the establishment of a stormwater evacuation project.

Prerequisites: none

020KARMM3 Karst **3 Cr.**
Topics covered include: Karstification. Different hydrogeological conceptions of karst. Systemic approach applied to karst. Chemical and isotopic tracing. Exploitation and protection of karst water resources.
Prerequisites: none

020SE1MM1 Mini Project 1 **4 Cr.**
Students will carry out a mini project in one of the courses of this semester.
Prerequisites: none

020SE2MM2 Mini Project 2 **4 Cr.**
Students will carry out a mini project in one of the courses of this semester.
Prerequisites: none

020HYPMM3 Physical Hydrology **3 Cr.**
Topics covered include: Energy transfers. Precipitation. Infiltration. Runoff. Evapotranspiration. River flow.
Prerequisites: none

020EPCMM3 Physicochemical Equilibria **3 Cr.**
Topics covered include: Main chemical, physical, and biological processes that influence the physicochemistry of natural waters. Chemical equilibria in solution (acid-base reactions, carbonate chemistry, redox equilibria, precipitation-dissolution). Reactions at the solid-liquid interface as well as interactions with aquatic organisms. Chemistry.
Prerequisites: none

020MSEMM4 Research Internship with Thesis **30 Cr.**
This course serves as an introduction to research techniques. It is the synthesis of four months of research work in a research center or laboratory.
Prerequisites: none

020MESMM2 Soil and Rock Mechanics **8 Cr.**
Topics covered include: Generalities. Properties and classification of soils. Clay minerals. Compaction and road geotechnics. Water in soils. Permeability, flow, and effective stress. Consolidation and settlements. Consolidation rate. Mohr’s circle and soil failure theories - Introduction to the mechanical properties of rocks. Environmental geotechnics. Practical Work (TP): Washed granulometric analysis - Sedimentometric granulometric analysis - Atterberg limits - Shear test - Proctor test - Oedometer test.
Prerequisites: none

020DECMM1 Solid Waste **4 Cr.**
Topics covered include: Urban waste. Collection. Cleaning of public roads. Treatment and recovery. Industrial and hospital waste. Waste recovery. Prerequisites: none

020ASTMM3 Spatial and Temporal Series Analysis **3 Cr.**
P Topics covered include: rincipal components and Kriging: interpolation and summation. Splines and Thiessen: confidence interval. Autocorrelation: autoregressive models - ARMA – ARMAX. Flood forecasting. Series generation. Markov processes and renewal theory. Prerequisites: none

020HSTMM1 Statistical Hydrology **4 Cr.**
Topics covered include: Statistical analysis of hydrological data. Graphical data representation. Extreme values of a variable. Correlative analysis. Simple and multiple regression. Statistical study of rainfall. Frequency analysis. IDF curves. Design rain. Example of a statistical model in hydrology.
Prerequisites: none

020RDMMM2 Strength of Materials **7 Cr.**
Topics covered include: Beam theory. Normal force. Bending. Torsion. Shear force. Calculation of the critical load of a structure: Euler's theory, Dutheil's theory. Energy theorems: Clapeyron, Maxwell-Betti Reciprocity, virtual work, Castigliano, Ménabréa. Three-moment method. Focal method. Section method. Elastic center method. Practical Work (TP): Compression test on concrete cylinder + ultrasound, extensometry, torsion, tensile test on metal bar. P
rerequisites: none

020QESMM3 Surface Water Quality **3 Cr.**
Topics covered include: Application of mathematical models to simulate the distribution and evolution of effluents discharged into lakes, reservoirs, rivers, estuaries, and oceans. Formulation of analytical models and simple numerical resolutions. Cycles of elements, such as oxygen, nitrogen, and phosphorus, as indicators of water quality. Salinity intrusion in estuaries. Eutrophication and sedimentation processes in lakes and reservoirs.
Prerequisites: none

020RESMM3 Underground Reservoirs **3 Cr.**
Topics covered include: Diffusivity equation. Consolidation - Permanent regime solutions of the diffusivity equation. Transient solutions of the diffusivity equation for flow tests. Mass and energy transport in porous media. Numerical solutions of flow and transport equations. Prerequisites: none

020CFTMM3 Water Management: Theory and Models, Water Resources, Water in the City 3 Cr.
Topics covered include: Principles, definitions, and implementation. Operational research. Linear and nonlinear programming. Dynamic and multicriteria programming. Simulation methods and tools for water resource allocation: competition and usage conflicts, technical and institutional modes of resource distribution. Agricultural water uses and water demand management: usage

practices and efficiencies, technical, economic, and regulatory instruments for regulation. Management of treatment and purification networks and systems.
Prerequisites: none

020TRAMM1 Water and Wastewater Treatment **4 Cr.**
Topics covered include: Potable water treatment. Microscreening. Adsorption. Water fluoridation and defluoridation. Wastewater management. Pretreatment. Biological purification. Sludge removal. Coagulation. Sedimentation. Filtration. Membrane techniques in liquid media. Reverse osmosis. Ultrafiltration. Distillation. Absorption.
Prerequisites: none

MASTER IN STRUCTURES AND SOIL MECHANICS

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The Master in Structures and Soil Mechanics imparts a sound scientific training in the field of civil engineering. This training offers students the possibility to prepare a dissertation in civil engineering.
The topics concern the civil engineering sector (analysis of structures, behavior of materials, reliability of constructions, geotechnics, geology, soil mechanics and soil dynamics, plates and shells, modeling and calculation by finite elements, Eurocodes, seismic and dynamic calculations, mechanics of structures, soil-structure interaction, etc.).
This Master program aims to form:

- Instructors and researchers
- High-level specialists, essential in the various concerned administrations and design offices
- Foreign researchers: due to the importance of the problems addressed, opening up to foreign students from the Mediterranean basin can bring about a synergy advantageous to better common use of resources.

Program Learning Outcomes (Competencies)

Students develop a set of skills that prepares them to comply with the complex challenges associated with the design, analysis and optimization of structures and foundations:

- Advanced structural design: in-depth understanding of advanced structural design principles, familiarizing the students with international standards and advanced calculation methodologies. This includes the design of complex structures
- Soil analysis: ability to analyze soil properties, evaluate their behavior under different loads and suggest appropriate geotechnical solutions. This includes the modeling of soil-structure interactions and geotechnical risk assessment
- Use of nonlinear calculation software: effective use of advanced modeling and simulation software
- Project management: management of resources and skills necessary to plan and execute a project
- Communication techniques: writing of detailed engineering reports, presentation of results in a clear and concise manner, efficient teamwork.

Admission Requirements

Candidates are selected following the study of the file provided by the student.

- Admission to the first semester of the Master (MR1) for candidates holding a Bachelor in Physics or an equivalent diploma.

- Admission to the third semester of the Master (MR3) for:
  - Civil engineering graduates
  - Holders of a Master or professional Master in physics
  - Third year civil engineering students at ESIB (fifth year of higher studies)
  - Holders of a recognized equivalent diploma.

The selection of candidates is made by an admission jury within the limits of available places.

Courses/Credits Granted by Equivalence

Civil engineering graduates, holders of a Master or professional Master in physics, fifth year civil engineering students at ESIB, and holders of a recognized equivalent diploma are granted 60 credits by equivalence:
Foundation Engineering (6 Cr.). Shear Strength and Geohazards (4 Cr.). Plates and Shells (4 Cr.). Structures Plastic Behavior (2 Cr.). Structural Dynamics and Earthquake Engineering (4 Cr.). Reinforced Concrete (6 Cr.). Multidisciplinary Project: Building Design, Foundations and Structures (6 Cr.). Strength of Materials (6 Cr.). Fluid Mechanics (6 Cr.). Soil and Rock Mechanics (6 Cr.). Structures (6 Cr.). Statistics (4 Cr.).

Program Requirements

120 credits: Required courses (120 credits)
This Master consists of 120 credits, divided in 4 semesters (MR1, MR2, MR3, and MR4) of around 30 credits each. The preparation of the Master includes:

- Theoretical and practical lectures
- Specialized seminars and conferences
- Technical visits
- A research internship in an approved center and on a dissertation subject.

MR1 (30 Cr.)

Fluid Mechanics (6 Cr.). Foundation Engineering (6 Cr.). Soil and Rock Mechanics (6 Cr.). Statistics (4 Cr.). Strength of Materials (6 Cr.). Structures Plastic Behavior (2 Cr.).

MR2 (30 Cr.)

Multidisciplinary Project: Building Design, Foundations and Structures (6 Cr.). Reinforced Concrete (6 Cr.). Plates and Shells (4 Cr.). Shear Strength and Geohazards (4 Cr.). Structural Dynamics and Earthquake Engineering (4 Cr.). Structures (6 Cr.).

MR3 (30 Cr.)

Behavior of Materials (3 Cr.). Calculation of Anelastic Structures (4 Cr.). Advanced Calculation of Concrete Structures (4 Cr.). Soil Dynamics (4 Cr.). Engineering Seismology (3 Cr.). Advanced Calculation of Steel Structures (3 Cr.). Advanced Statistics and Operational Research (3 Cr.). Design and Reliability of Structures (3 Cr.). Advanced Modeling of Materials and Structures (3 Cr.).

MR4 (30 Cr.)
Research Internship and Dissertation (30 Cr.).

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020PLSMM1	Structures Plastic Behavior	2
020FOSMM1	Foundation Engineering	6
020MEFMM1	Fluid Mechanics	6
020MESMM1	Soil and Rock Mechanics	6
020RDMMM1	Strength of Materials	6
020STAMM1	Statistics	4
	Total	**30**

Semester 2

Code	Course Name	Credits
020BEAMM2	Reinforced Concrete	6
020DYSMM2	Structural Dynamics and Earthquake Engineering	4
020STRMM2	Structures	6
020RCGMM2	Shear Strength and Geohazards	4
020PLCMM2	Plates and Shells	4
020PBAMM2	Multidisciplinary Project: Building Design, Foundations and Structures	6
	Total	**30**

Semester 3

Code	Course Name	Credits
020COMMM3	Behavior of Materials	3
020CSAMM3	Calculation of Anelastic Structures	4
020EC2MM3	Advanced Calculation of Concrete Structures	4
020DYSMM3	Soil Dynamics	4
020SISMM3	Engineering Seismology	3
020EC3MM3	Advanced Calculation of Steel Structures	3
020SROMM3	Advanced Statistics and Operational Research	3
020CFOMM3	Design and Reliability of Structures	3
020MMSMM3	Advanced Modeling of Materials and Structures	3
	Total	**30**

Semester 4

Code	Course Name	Credits

020MSMMM4	Research Internship and Dissertation	30
	Total	**30**

Course description

a- Semesters MR1 and MR2

020MEFMM1 Fluid Mechanics 6 Cr.
This course introduces students to the basic principles of fluid statics and dynamics. Topics covered include: Fluid statics – Continuity equation – Momentum equation – Energy equation – Differential formulation of the governing equations - Potential flow theory - Dimensional analysis and similitude – Viscous fluid flow – Introduction to turbulent flow.

020FOSMM1 Foundation Engineering 6 Cr.
This course introduces students to the calculation methods and rules of the art in the field of design and construction of foundations and retaining structures. Topics covered include: Identify the mechanical and hydraulic properties of soils. Understand the principles of geotechnical investigation as well as the main field tests. Dimension conventional superficial foundations. Understand the principles of active and passive pressures, and apply them to the calculation of retaining walls and different types of walls. Excavations and Groundwater Control. Deep Foundations. Design the piles. Geotechnical Design.

020MESMM1 Soil and Rock Mechanics 6 Cr.
Generalities. Properties and classification of soils. Clay minerals. Compaction and road geotechnics. Water in soil. Permeability, flow and effective stress. Consolidation and settlements. Consolidation speed. Mohr's circle and soil failure theories. Introduction to rock mechanical properties. Environmental geotechnics. Laboratory: sieve analysis, Hydrometer analysis, Atterberg limits, shear test, Proctor compaction test, oedometer consolidation test.

020STAMM1 Statistics 4 Cr.
This course introduces students to basic statistics. Topics covered include: Central limit theorem - sampling distributions - qualities of the estimators - Estimation by confidence intervals - estimation by the maximum likelihood method - estimation by the moments method - tests of parametric hypotheses - Linear regression (simple and multiple) - tests of non-parametric hypotheses - bootstrap - introduction to Bayesian statistics - Monte Carlo method - Monte-Carlo methods by Markov chains (MCMC) - approximate Bayesian calculation (ABC).

020RDMMM1 Strength of Materials 6 Cr.
This course enables students to understand the behavioral law of the materials, calculate and analyze the characteristics of the cross sections, as well as distribute the internal efforts and stresses in the different elements of 2D structures and the deformations of these elements. Topics covered: Theory of beams – Characteristics of the cross section - Center of Gravity - Moment of inertia – Normal effort - Bending - Torsion - Shear – Combined loadings - Calculation

of the critical load of a structure: Theory of Euler - Energy theorems: Clapeyron, Maxwell-Betti, Bertrand de Fonviolant, virtual works, Castigliano, Menabrea - Force method - Three moments method.

020PLSMM1 Structures Plastic Behavior 2 Cr.

This course equips students with the basic elements of plasticity, currently used in the new calculation codes in civil engineering. Topics covered include: Generalities on plasticity calculation and plasticity criteria, Plastic traction and Compression, Plane plastic bending and notion of plastic hinge, Plastic resistance of sections in the presence of interaction between the internal forces - Calculation of the collapse load of statically indeterminate structures: Using the step-by-step method, Using the theorems of limit analysis.

020PBAMM2 Multidisciplinary Project: Building Design, Foundations and Structures 6 Cr.

This course covers the design of foundations and structural elements of reinforced concrete building. Topics covered include: Calculation of the foundations of a building - Calculation of the structure and dimensioning of the structural elements of a reinforced concrete building..

020PLCMM2 Plates and Shells 4 Cr.

This course covers the theoretical elements needed to pre-dimension and analyze structural elements such as slabs, walls, roof, tanks and folded structures. Topics covered include: General introduction on plates and shells - Kirchhoff's theory of plates - Bending theory of rectangular plates - Bending theory of circular plates - Theory of shells - Membrane theory of shells of revolution - Bending theory of shells of revolution - Junction of shells of revolution.

020BEAMM2 Reinforced Concrete 6 Cr.

This course consists of dimensioning reinforced concrete structural elements according to BAEL and Eurocode 2. Topics covered include: Introduction - General - Bases of semi-probabilistic calculation - Evolution of calculation methods for reinforced concrete - Characteristics of materials - Durability and Coating - Adherence - Constructive provisions - Theory of cracking - Simple traction - Study of columns - Simple compression - Composite bending - Study of beams - Simple bending - Shear force - Study of beams - Torsion - Seismic arrangements - Practical work: Strength of concrete (Mechanical compression - Sclerometer - Pundit) - Test Los Angeles - Determination of concrete - Cleanliness of sand.

020RCGMM2 Shear Strength and Geohazards 4 Cr.

Key topics include: Understand influence factors and plan the measurement of soil shear strength under static and cyclic loading modes; Understand the basis of soil rheology; Introduce the notions of the effect of earthquakes on soils in terms of failure mode; Analyze landslide problems in terms of slope stability, excavations and embankments. Apply geotechnics to environmental problems; Identify the nature of contaminants in the soil with their biological, chemical and physical properties; Understand the modes of transport of contaminants in order to calculate their concentration in time and space; Develop treatment methods for soil decontamination; Design landfills..

020DYSMM2 Structural Dynamics and Earthquake Engineering 4 Cr.

This course equips students with the necessary elements to understand the dynamics of the structures and size them to withstand earthquakes according to the PS92 regulation. Topics covered include: Earthquakes - Single Oscillator - Multiple Oscillator - Response of a structure to an earthquake - Calculation from an accelerogram - Calculation from a response spectrum - Regulatory aspects - Structural modeling - Seismic design - Rules PS92: Design, calculation and construction - Applications - Study of some works according to PS92.

020STRMM2 Structures 6 Cr.

This course covers structural forms; influence lines; effects of temperature loads on structures, analysis of arches, trusses, continuous beams, 2D frames, grids and 3D frames. Topics covered include: Calculation of 2D structures (Rotation Method and Hardy-Cross Method) - Study of Arcs - Study of 3D structures - Method of displacements - Study of the stability of structures - Study of influence, use of lines of influence and applications - Beams on elastic supports - Beams on elastic soil - Study of the effect of temperature on structures – Software applications.

b- Semesters MR3 and MR4

020COMMM3 Behavior of Materials 3 Cr.

Deformation and kinematics. Conservation law. Virtual work. Constitutive equation. Thermo-mechanics.

020CSAMM3 Calculation of Anelastic Structures 4 Cr.

Step by step method. Static theorem. Kinematic theorem. Regulatory aspect. Optimization.

020EC2MM3 Advanced Calculation of Concrete Structures 4 Cr.

Reinforcement optimization calculation. Limited redistribution of moments (comparison of methods). Design of reinforced concrete structural systems and their members according to EC2. Advanced torsion calculation. Reinforcement in seismic calculation (with comparison between different codes).

020DYSMM3 Soil Dynamics 4 Cr.

Introduction to seismic geotechnics. Characterization of seismic movements. Laboratory and field site methods. Cyclic behavior of granular and clay soils. Liquefaction. Dynamic response calculation.

020SISMM3 Engineering Seismology 3 Cr.

Seismic hazard. Seismic risk. Zoning.

020EC3MM3 Advanced Calculation of Steel Structures 3 Cr.

Calculation basis for Eurocodes 3 and 4. Calculation of assemblies. Mixed calculation of slabs. Mixed calculation of columns.

020CFOMM3 Design and Reliability of Structures **3 Cr.**
Reliability theory. Structural performance. Potential design risks. Capacity factor. Evaluation of the different variables that affect the design.

020SROMM3 Advanced Statistics and Operational Research **3 Cr.**
Decision analysis. Simulations. Markov decision process. Response surface methodology. Regression analysis. Stochastic process.

020MMSMM3 Advanced Modeling of Materials and Structures **3 Cr.**
Advanced nonlinear structural calculation. GMNIA. MNA. LBA.

020MSMMM4 Research Internship and Dissertation **30 Cr.**
This course constitutes an introduction to research techniques. It is the synthesis of four months of research in a research center or laboratory.

MASTER IN ARTIFICIAL INTELLIGENCE

Main Language of Instruction:

Français : □	Anglais : ◙	Arabe : □

Campus Where the Program Is Offered: CST

Objectives

The Master's degree in Artificial Intelligence (AI) is a professional program to prepare experts capable of developing intelligent programs and systems to be implemented in different industries for the betterment of mankind. Our graduates have expertise in a wide range of AI-related fields such supervised and unsupervised Machine Learning (ML) and Deep Learning (DL), Reinforcement Learning, Big Data Analysis and Modeling, Data Mining, Statistics as well as the development of parallel and distributed AI-based software. It is a professional master program that meets the needs of the job market but also provides the theoretical basis that enables students to pursue doctoral studies in this field. The program features theoretical & practical lectures, extensive hands on experience and an internship in a company or a research internship leading to the writing of a thesis and a defense. Our graduates are presented with a wide range of opportunities in the fields of Machine Learning (ML), Deep Learning (DL), Computer Vision (CV), Natural Language Processing (NLP), Generative AI (GenAI), Large Language Models (LLM), Internet of Things (IoT) with applications in software development, robotics, healthcare, fintech and others.

Program Learning Outcomes (Competencies)

1. **Acquire and apply advanced knowledge appropriate to the discipline**
   1.1. Acquire theoretical and practical concepts appropriate to the discipline
   1.2. Demonstrate proficiency in applying theoretical concepts to practical problems within the discipline
2. **Solve critical issues and demonstrate expertise in key areas in the field of study**
   2.1. Identify and evaluate key challenges in the field
   2.2. Solve critical issues by using advanced mathematics and sciences
   2.3. Exhibit depth of knowledge in specialized areas
3. **Apply new and diversified theoretical and experimental methods as appropriate to the discipline**
   3.1. Demonstrate the ability to learn and apply new methods and technologies
   3.2. Utilize advanced analytical tools and techniques to solve complex issues in the field
   3.3. Integrate new technologies into existing systems to improve performance
4. **Communicate, at an advanced level, in oral and written form**
   4.1. Prepare clear, concise, and well-organized written reports on complex topics
   4.2. Deliver effective oral communications, demonstrating mastery of the subject matter

Admission Requirements

Admission of students is based on their file and an interview might be required.

1- Admission to the first semester of the Master's program (S1)

To be authorized to submit application files, students must satisfy one of the following conditions:

- Hold a Bachelor in Computer and Communications Engineering, Computer Science, or Telecommunications;
- Hold an equivalent degree recognized by USJ.

2- Admission to the third semester of the Master's program (S3)

To be authorized to submit application files, students must satisfy one of the following conditions:

- Hold a Bachelor of Engineering in Computer and Communications Engineering or being a CCE student at ESIB and have earned at least 120 credits in the Engineering Cycle.
- Hold a Master's degree in Computer Science, Computer and Communications, or Informatics.
- Hold an equivalent degree recognized by USJ.

The documents required when submitting the application form are specified in the common admission file specific to the Saint Joseph University of Beirut.
The submitted files will be examined by the Scientific Committee of the Faculty of Engineering and Architecture, which will subsequently establish the list of admitted candidates. For each application, the Scientific Committee will decide on the validated courses according to the program and the obtained previously results. Selected candidates might be interviewed before their final admission. The application file is downloadable from the Saint Joseph University of Beirut's[2] website and is to be submitted at the **School of Engineering of Beirut (ESIB) at USJ.**

Courses/Credits Granted by Equivalence

Engineers with degrees in computer engineering and/or communications, holders of a Master's degree in computer science or information technology, fifth-year CCE students at ESIB and holders of an equivalent diploma, can validate, by equivalence, a maximum of 60 credits of the program. Upon approval from the Director of the Department of Doctoral Studies, the admissions jury will decide, for each student accepted directly in M3, the set of validated courses and modules based on their background and their results. It will define accordingly their path in the Master's program, possibly including additional prerequisite courses. The

[2] https://usj.edu.lb/esib/diplome.php?diplome=1057

validation of previously pursued programs is subject to approval by the USJ Equivalence Commission.

Program Requirements

Required courses (120 credits)

Artificial Intelligence (4 Cr.), Graph Theory and Operations Research (4 Cr.), Mathematics for AI & Machine Learning (4 Cr.), Natural Language Processing (4 Cr.), Optimization for AI (4 Cr.), Programming for AI & Machine Learning (6 Cr.), Statistics for AI & Machine Learning (4 Cr.), AI in Computer Vision (4 Cr.), AI in Financial Technology (4 Cr.), AI in Robotics (4 Cr.), Game Theory (4 Cr.), Foundations of Decision Modeling (5 Cr.), Machine Learning (4 Cr.), Parallel Computing (5 Cr.), AI-Based Control Systems (4 Cr.), AI for Business and Marketing (6 Cr.), AI in Cybersecurity (4 Cr.), Big Data Frameworks (4 Cr.), Generative AI (4 Cr.), Legal, Policy, and Ethical Considerations for Data Scientists and AI (4 Cr.), Software Engineering for AI (4 Cr.), Master's Thesis (30 Cr.).

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020IA2ES4	Artificial Intelligence	4
048DSTGM1	Graph Theory and Operations Research	4
020IAMAM1	Mathematics for AI & Machine Learning	4
020IANLM1	Natural Language Processing	4
020OPAIM1	Optimization for AI	4
020IAOOM1	Programming for AI & Machine Learning	6
020IASTM1	Statistics for AI & Machine Learning	4
	Total	**30**

Semester 2

Code	Course Name	Credits
020IACVM2	AI in Computer Vision	4
020IAFIM2	AI in Financial Technology	4
020IAROM2	AI in Robotics	4
020IAGAM2	Game Theory	4
020IADMM2	Foundations of Decision Modeling	5
020IAMLM2	Machine Learning	4
020IAPCM2	Parallel Computing	5
	Total	**30**

Semester 3

Code	Course Name	Credits
020IARBM3	AI-Based Control Systems	4
020IABMM3	AI for Business and Marketing	6

020IACSM3	AI in Cybersecurity	4
020BDFRM3	Big Data Frameworks (Mining Massive Datasets)	4
020GAIES5	Generative AI	4
020IALPM3	Legal, Policy, and Ethical Considerations for Data Scientists and AI	4
020IAIDM3	Machine Learning Operations	4
	Total	**30**

Semester 4

Code	**Course Name**	**Credits**
020IAINM4	Master Thesis	30
	Total	**30**

Course description

Semester S1 (30 credits)

020IA2ES4 Artificial Intelligence 4 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. We first cover greedy and A* search, the implementation of games through the minimax and expectimax algorithms, Markov Decision Processes (MDP), and Reinforcement Learning (RL). We then introduce Machine Learning (ML) algorithms with some applications.

048DSTGM1 Graph Theory and Operations Research 4 Cr.

This teaching unit introduces students to the graph theory and operational research as modeling and decision-making tools for the data scientist. Therefore, students will learn to make a mathematical and computer representation of graphs, apply the algorithms for traversing the graphs, calculate the shortest path, maximize a flow problem, analyse complex networks, use the NetworkX Python library, use Markov chains to solve real-world problems, understand the Simplex algorithm and linear programming, use numerical tools for solving optimization problems.

020IAMAM1 Mathematics for AI & Machine Learning 4 Cr.

This course is designed to enhance students' mathematical skills, which are essential for other courses in this major. We start with the basics, including scalars, vectors, matrices, and tensors, and then progress to more advanced topics such as the Hadamard product, dot product, and various matrix types including identity, diagonal, symmetric, orthonormal, orthogonal, and inverse matrices. The course also covers solving linear equations, L^p and L^∞ norms, the Frobenius norm, eigen decomposition, diagonalization, singular value decomposition (SVD), the Moore-Penrose pseudoinverse, derivatives, gradients, the chain rule, local and absolute maxima and minima, Lagrange multipliers, and Taylor's Formula. Finally, students are requested to do a project demonstrating how these mathematical concepts can be applied in AI and machine learning.

020IANLM1 Natural Language Processing 4 Cr.

This course aims to dive into the fascinating world of Natural Language Processing (NLP), a cutting-edge field of Artificial Intelligence (AI) that empowers machines to understand, interpret, and generate human language. The course offers a comprehensive exploration of NLP, equipping students with the skills to leverage language technologies in various applications and industries. From another hand, with the rapid advancement in digital technologies and an explosion of research publications, NLP is becoming increasingly pivotal. This course is designed for individuals eager to harness the power of NLP in their careers or research endeavors. Whether Audiences are aiming to enhance customer interactions, analyze sentiment, or detect anomalies, this course will provide them with a competitive edge in today's data-driven world.

020OPAIM1 Optimization for AI 4 Cr.

This course delves into the mathematical optimization techniques essential for developing and refining machine learning algorithms and AI applications. Focusing on theoretical foundations, this course explores deep neural network initialization, gradient descent techniques, automatic differentiation and backpropagation, and adaptive learning rate algorithms such as Adam and RMSProp. Additionally, it covers principal component analysis (PCA), density estimation algorithms, and support vector machines (SVM). Students will learn to solve unconstrained and constrained optimization problems, apply these methods to neural networks, and enhance model performance. The course provides a comprehensive understanding of optimization's role in AI, equipping students with the theoretical knowledge to tackle complex challenges in various AI domains.

020IAOOM1 Programming for AI & Machine Learning 6 Cr.

The main purpose of this course is to give students the necessary tools for the development of advanced level programs by using the concept of objects in their programs. This program focuses on the fundamental building blocks you will need to learn to become an AI practitioner. Specifically, students will learn programming skills, and essential math for building an AI architecture. They will even dive into neural networks and deep learning.

020IASTM1 Statistics for AI & Machine Learning 4 Cr.

This course provides a basic high-level introduction to the mathematics and statistics that underpin many of the modern machine learning and AI algorithms. The course will cover two broad areas of statistics: inference and prediction. The inference portion introduces statistical concepts to understand populations and test hypotheses (e.g., A/B tests, p-values), while the prediction section covers algorithms from linear regression to more advanced topics like random forests and cross-validation. Real-world examples are drawn from healthcare, genetics, marketing, and manufacturing.

Semester S2 (30 credits)

020IACVM2 AI in Computer Vision 4 Cr.

This course aims to study the image processing techniques: filtering morphology edge detection and segmentation. Then we apply artificially intelligent technique to detect features in images aiming to detect an image in a scene. Then we pass to the camera to see the calibration and the computer vision. Lab on MATLAB or/and python will be done to explain all AI methodologies. We will finish by the processing of images using Convolutional neural networks.

020IAFIM2 AI in Financial Technology 4 Cr.

Technology is playing an increasingly dominant role in the financial service industry. It is changing how existing players operate and it is creating new ways to deliver core services like saving, investing, borrowing, and transacting. The aim of this course is to develop machine learning and AI techniques to provide solutions in the finance industry, with a focus on credit risk assessment, decision-making, and an introduction to algorithmic trading.

020IAROM2 AI in Robotics 4 Cr.

This course covers the fundamental concepts of game theory and strategic thinking; normal form games; Nash equilibrium; strategies (dominated, pareto-optimal, mixed, max-min, min-max); extensive form games (with perfect/imperfect information); repeated games.

020IAGAM2 Game Theory 4 Cr.

This course covers the fundamental concepts of game theory and strategic thinking; normal form games; Nash equilibrium; strategies (dominated, pareto-optimal, mixed, max-min, min-max); extensive form games (with perfect/imperfect information); repeated games.

020IADMM2 Foundations of Decision Modeling 5 Cr.

Preferences are present and pervasive in many situations involving human interaction and decisions. Preferences are explicitly or implicitly expressed in numerous applications and relevant decisions should be made based on these preferences. This course aims at introducing preference models for multicriteria decisions. It covers concepts and methods for preference modeling and multicriteria decision making, convex optimization as a decision tool, decision under uncertainty, decision trees, expected utility theory and its applications, Markov decision processes and their application.

020IAMLM2 Machine Learning 4 Cr.

Machine learning (ML) is a subfield of Artificial intelligence. It is the science of making the machine learn by examples. The goal of ML is to make a computer that can learn from examples autonomously. The main research topics in ML include: Computer Vision (CV) and Natural Language Processing (NLP) and precision medicine for personalized treatments. The main goal of this course is to acquire a basic understanding of ML algorithms as well as hands-on ML engineering experience with regards to its application to realistic datasets through Python implementations that make use of state-of-the-art libraries such as Scikit-learn, Tensorflow and Keras.

020IAPCM2 Parallel Computing 5 Cr.

Parallel architectures – Parallel Computing – Concurrency and Threads – Parallelism in Python & OpenMP – Message Passing Interface (MPI) using mpi4py – Heterogeneous programming and GPUs with CUDA and Python.

Semester S3 (30 credits)

020IARBM3 AI-based Control Systems 4 Cr.

In this course, two intelligent techniques for data processing drawn from complex and imprecise environment are presented and studied. Fuzzy Logic theory is based on the empirical aspect of the human reasoning, and is used in the manipulation of imperfect, imprecise or approximate knowledge. It allows the modeling and processing of very complex systems in which, for example, human factors are present. Theory and applications concerning fuzzy logic exit for more than fifty years. They cover several fields such as artificial intelligence, identification and control of dynamic systems, automatic decision-making in complex systems, and fault diagnosis in industrial processes. On the other hand, Artificial Neural Networks are based on the biological aspect of the human brain. They are currently widely applied in various sectors such as telecommunication systems, automation, robotics, image processing and recognition, artificial intelligence, medicine and economics.

020IABMM3 AI for Business and Marketing 6 Cr.

This course explores the integration of artificial intelligence tools and techniques in business and modern marketing practices. Students will delve into the utilization of AI algorithms, machine learning models, and data analytics to optimize marketing strategies across various digital channels and business decision-making. Through real-world applications and hands-on experience, students will learn to personalize content, enhance customer engagement, and drive ROI through targeted advertising and dynamic pricing. The course emphasizes ethical considerations and responsible AI usage, empowering business to leverage technology effectively while maintaining integrity and trust.

020IACSM3 AI in Cybersecurity 4 Cr.

This course provides a comprehensive overview of the intersection between artificial intelligence (AI) and cybersecurity.We will explore the fundamental principles of AI, its applications in both offensive and defensive cyber operations, and the potential risks associated with AI in the cybersecurity landscape.

020BDFRM3 Big Data Frameworks 4 Cr.

This course introduces students to distributed computing paradigms and big data processing techniques. It focuses on data parallel processing using MapReduce and Apache Spark. Students will gain hands-on experience in managing and analyzing large-scale datasets in distributed environments.

020GAIES5 Generative AI 4 Cr.

This course aims to immerse students in the transformative field of Generative AI, a groundbreaking area of Artificial Intelligence focused on creating content, models, and solutions that mimic human-like creativity and intelligence. The course offers a comprehensive introduction to generative models, equipping you with the knowledge and skills to harness the power of AI to generate text, images and more. Generative AI is at the forefront of technological innovation, enabling new forms of creativity and automation. This course is designed for professionals, researchers, and enthusiasts eager to explore the cutting-edge of AI and its potential to revolutionize various domains. This course covers the principles, methodologies, and applications of generative models, equipping students with the knowledge and skills to utilize these technologies in various domains of technology.

020IALPM3 Legal Policy and Ethical Considerations for Data Scientists and AI 4 Cr.

The purpose of this course is to give the audience, a general understanding of regulations on AI (existing and under development): the principles, standards and policies adopted by the different regulators when issuing such rules, how these are applied and how they will evolve. Throughout the course we will be addressing the general legal provisions and framework which accompanying the different regulations while focusing on the applicability of such regulations (within the relevant jurisdictions and abroad), the need for standardization processes (namely through international forums such as the UN and the OECD), the effectiveness of such regulations and the importance of ethics in the "AI world" from legal and compliance perspectives.

020IAIDM3 Machine Learning Operations 2 Cr.

The Machine Learning Operations course provides a comprehensive exploration of software engineering principles tailored for AI applications. It covers the entire software development lifecycle (SDLC) for AI projects, including requirements engineering, design patterns for machine learning applications, and software design for AI systems. The course delves into development tools and techniques essential for AI software development, and emphasizes machine learning operations (MLOps) such as model training and deployment pipelines, model monitoring and performance evaluation, version control and management of machine learning models, and responsible AI practices focusing on bias, fairness, and explainability.

Semester S4 (30 crédits)

020IAINM4 Master Thesis 30 Cr.

During the 4th semester, students must complete a professional project in a company or research work in a laboratory for 4 months on an AI-related topic.

- They have the choice between:
  - A professional project in a company lasting 3 to 4 months, on a theme related to AI, concluded by writing and defending a professional report.
  - A research topic lasting 3 to 4 months in a laboratory recognized by the Scientific Committee, concluded by writing and defending a research paper.

- The projects will take place in companies in Lebanon or abroad. The scientific responsibility for the project is provided jointly, by the company and an instructor from USJ or a partner university. This project, of a minimum of one semester, aims to develop all the skills necessary for an AI specialist:
  - Bibliographic search.
  - Study of the state of the art.
  - Proposal and implementation of solutions.
- The research takes place in a laboratory either in Lebanon or in an external institution. Scientific responsibility for this research is provided by the research professor(s) who supervise them. This work, of a minimum duration of one semester, aims to develop the necessary skills to carry out research work:
  - Bibliographic search.
  - Critical analysis of the state of the art.
  - Proposals and implementations of solutions.
  - Proposals and outlets for thesis work.
- The project or research work is the subject of a report or a written dissertation and a public defense. Students who have validated the theoretical modules of semesters 1, 2, and 3 are authorized to submit the project report and possibly the research paper.

  The thesis or report includes a bibliographic part and a technical part. The evaluation of the project or research work considers three elements:
  - Evaluation of the trainee’s scientific initiative.
  - Evaluation of the written brief or report.
  - Evaluation of the oral defense.

MASTER IN DATA SCIENCE

Main Language of Instruction:

French: □	English: ◙	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

This Master aims to train:

- Specialists at a high level who can design and use new tools for collecting massive data and process them using appropriate algorithms.
- Researchers with expertise in computer science, applied mathematics, and statistics.
- Designers of database management systems that can ensure the quality, security, and accessibility of information.
- Multidisciplinary consultants capable of transforming information into decision support tools within a company.

Program Learning Outcomes (Competencies)

5. **Acquire and apply advanced knowledge appropriate to the discipline**
   5.1. Acquire theoretical and practical concepts appropriate to the discipline
   5.2. Demonstrate proficiency in applying theoretical concepts to practical problems within the discipline
6. **Solve critical issues and demonstrate expertise in key areas in the field of study**
   6.1. Identify and evaluate key challenges in the field
   6.2. Solve critical issues by using advanced mathematics and sciences
   6.3. Exhibit depth of knowledge in specialized areas
7. **Apply new and diversified theoretical and experimental methods as appropriate to the discipline**
   7.1. Demonstrate the ability to learn and apply new methods and technologies
   7.2. Utilize advanced analytical tools and techniques to solve complex issues in the field
   7.3. Integrate new technologies into existing systems to improve performance
8. **Communicate, at an advanced level, in oral and written form**
   8.1. Prepare clear, concise, and well-organized written reports on complex topics
   8.2. Deliver effective oral communications, demonstrating mastery of the subject matter

Admission requirements

Admission of students is based on their file and an interview might be required.

- For applications to the first semester of the Master’s program, students must hold a Bachelor in Computer and Communications Engineering, Computer Science, or Mathematics, or hold an equivalent degree recognized by USJ.

- For applications to the third semester of the Master's program, students must hold a Bachelor of Engineering in Computer and Communications Engineering, be a CCE student at ESIB and have earned at least 120 credits in the Engineering Cycle, or hold a Master in Computer Science, or Computer and Communications, Mathematics or an equivalent degree recognized by USJ.

Courses/Credits Granted by Equivalence

ESIB CCE graduates, holders of a Bachelor's or professional Master's degree in Computer Science or Mathematics, fifth-year ESIB CCE students, and holders of a recognized equivalent diploma, can validate up to 60 credits of the program by equivalence, depending on the courses they already passed in their previous or current curriculum, and depending on the decision of the admission jury.

Program requirements

120 credits: Required courses (116 credits), Institution's elective courses (4 credits).

Required courses (116 Cr.):
Cloud and Digital Transformation (4 Cr.), Graph Theory and Operational Research (4 Cr.), Inferential Statistics (6 Cr.), Natural Language Processing (4 Cr.), Optimization for AI (4 Cr.), Programming for Data Science and Artificial Intelligence (4 Cr.), Data Visualization and Communication (4 Cr.), Enterprise Data Management (5 Cr.), Machine Learning and Deep Learning (4 Cr.), Marketing Data Science (5 Cr.), Mining Massive Data Set (4 Cr.), Regression Models (4 Cr.), Social Big Data (4 Cr.), AI for Business and Marketing (6 Cr.), Applied Regression and Time Series Analysis (4 Cr.), Big Data Frameworks (4 Cr.), Generative AI (4 Cr.), Legal, Political and Ethical Considerations for Data Scientists and AI (4 Cr.), Software Engineering for AI (4 Cr.), Theoretical Guidelines for High-Dimensional Data Analysis (4 Cr.), Master Dissertation (30 Cr.).

Institution's elective courses (4 Cr.):
Students will choose one of the following two courses: Mathematics for Data Science and AI (4 Cr.) or Relational Database (4 Cr.).

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020CTDIM1	Cloud and Digital Transformation	4
048DSTGM1	Graph Theory and Operational Research	4
048DSSIM1	Inferential Statistics	6
048DSPMM1	Programming for Data Science and Artificial Intelligence	4

020OPAIM1	Optimization for AI	4
020IANLM1	Natural Language Processing	4
020IAMAM1 020BDREM1	Mathematics for Data Science and AI (Elective) Or Relational Database (Elective)	4
	Total	**30**

Semester 2

Code	**Course Name**	**Credits**
020INTDM2	Enterprise Data Management	5
020DVCOM3	Data Visualization and Communication	4
020IAMLM2	Machine Learning and Deep Learning	4
020BDFRM2	Big Data Frameworks	5
020MMDES4	Mining Massive Data Sets	4
048DSSBM1	Social Big Data	4
048MBCMM2	Regression Models	4
	Total	**30**

Semester 3

Code	**Course Name**	**Credits**
048DSARM3	Applied Regression and Time Series Analysis	4
020IABMM3	AI for Business and Marketing	6
020MADSM3	Marketing Data Science	4
020GAIES5	Generative AI	4
020IALPM3	Legal, Political and Ethical Considerations for Data Scientists and AI	4
020IAIDM3 3	Machine Learning Operations	4
048DSTGM3	Theoretical Guidelines for High-Dimensional Data Analysis	4
	Total	**30**

Semester 4

Code	**Course Name**	**Credits**
020STGEM4	Master Dissertation	30
	Total	**30**

Course description

020CTDIM1 Cloud and Digital Transformation 4 Cr.

Cloud computing and big data are currently the two main technological developments driving companies' growth in the digital sector. Big data, achieved through the collection and analysis of large amounts of data, represents the potential for new activities in many sectors. Cloud computing allows anywhere and on-demand access to digital services, resulting in significant

cost reductions. These two subjects are closely linked: cloud computing is the only technology capable of supporting the computation of problems defined by big data.
This course introduces cloud-based big data solutions, such as AWS's big data platform. Students will learn how to utilize existing cloud services to process data using the vast ecosystem of tools, how to create big data environments and apply the best practices to secure those environments in an economical approach.

048DSTGM1 Graph Theory and Operational Research 4 Cr.
This course introduces students to graph theory and operational research as modeling and decision-making tools for the data scientist. By the end of the course, students will be able to make mathematical and computer representations of graphs, apply graph traversal algorithms, calculate the shortest path, maximize flow problems, analyze complex networks, use the NetworkX Python library, use Markov chains to solve real-world problems, understand the Simplex algorithm and linear programming, and use numerical tools for solving optimization problems.

048DSSIM1 Inferential Statistics 6 Cr.
Statistical inference consists of predicting the unknown characteristics of a population based on a sample drawn from this population. Thus, the objective of statistics is symmetrical to that of probability. By the end of this course, students will be able to conduct a complete statistical study: spanning from selecting appropriate statistical models, to estimating unknown quantities and making informed decisions. The applications attributed during this course are led using the R language software mainly for data manipulation, implementing statistical procedures, plotting graphics and functions and presenting results in a comprehensible way.

048DSPOM1 Programming Languages for Data Science and Artificial Intelligence 4 Cr.
This course equips students with the necessary tools for developing advanced-level programs understanding the Object-Oriented Programming (OOP) approach. The first part of the course focuses on the C++ language while the second part delves into Python and its functionalities relevant to data science. In the final part, students are introduced to machine learning examples using Python, allowing exploration of the power of the libraries provided by the Python community.

020IAMAM1 Mathematics for AI and Machine Learning 4 Cr.
Artificial Intelligence has gained importance in the last decade with a lot depending on the development and integration of AI in our daily lives. The progress that AI has already made is astounding with the self-driving cars, medical diagnosis and even beating humans at strategy games like Go and Chess.
The future for AI holds tremendous promise, potentially leading to the creation of robotic companions. Consequently, many developers are now diving into AI and ML programing. However, mastering AI and ML algorithms demands a strong understanding of mathematics.
Mathematics plays an important role as it builds the foundation for programming for these two streams. This course will help students master the mathematical foundation required for writing programs and algorithms for AI and ML.

The course covers three main mathematical theories: Linear Algebra, Multivariate Calculus and Probability Theory.

020IANLM1 Natural Language Processing 4 Cr.

This course goes beyond the phase of gathering large amounts of data by focusing on how machine learning algorithms can be rewritten and scaled to work on petabytes of both structured and unstructured data simultaneously, to generate sophisticated models used for making predictions. Conceptually, the course is divided into two parts.

The first part covers deep learning and key network architectures, including: convolutional neural networks, autoencoders, recurrent neural networks, and long short-term memory (LSTM) networks. This part also addresses stochastic networks, conditional random fields, Boltzmann machines, stochastic and mixed deterministic models, as well as deep reinforcement learning.

The second part focuses on natural language processing (NLP): Research in automatic natural language processing is a subfield of artificial intelligence aimed at developing automated techniques for manipulating linguistic data. Immediate applications of these techniques include the development of more natural textual interfaces, automatic document translation, spam detection, information retrieval from document collections based on queries, question/answer systems, and more. This part introduces students to the following topics: Introduction to the problem of automatic natural language processing and its applications. The relationship between natural language and formal languages: the problem of ambiguity. An overview of current linguistic theories. Speech analysis and synthesis. Morphological analysis: structure of the dictionary and suffix analysis. Syntactic analysis: ATN parsers, unification grammars, and the representation of the semantics of natural languages: formal logic and frameworks. Semantic interpretation. World knowledge and speech context. Applications.

020OPAIM1 Optimization for AI 4 Cr.

This course delves into the mathematical optimization techniques essential for developing and refining machine learning algorithms and AI applications. Focusing on theoretical foundations, this course explores deep neural network initialization, gradient descent techniques, automatic differentiation and backpropagation, and adaptive learning rate algorithms such as Adam and RMSProp. Additionally, it covers principal component analysis (PCA), density estimation algorithms, and support vector machines (SVM). Students will learn to solve unconstrained and constrained optimization problems, apply these methods to neural networks, and enhance model performance. The course provides a comprehensive understanding of optimization's role in AI, equipping students with the theoretical knowledge to tackle complex challenges in various AI domains.

020BDREM1 Relational Database 4 Cr.

This course introduces the design, creation and management of databases. It allows students to master the concept of "Database," designing a database for a given Information System (IS), understanding the Relational Model, acquiring skills in creating and managing a database using SQL language, and understanding the techniques of database management systems.

020INTDM2 Enterprise Data Management 5 Cr.

"Enterprise Data Management (EDM) is the ability of an organization to precisely define, easily integrate and effectively retrieve data for both internal applications and external communication. EDM focuses on the creation of accurate, consistent, and transparent content." (Wikipedia)

This course addresses the challenges of enterprise data management at scale, primarily focusing on data architecture, data modeling and data integration, both on-premise and on the cloud. It covers different enterprise data architectures such as Data Warehouses, and Data Lakes. Additionally, it details various data models (including structured, semi-structured (XML), unstructured, and semantic data with RDF/OWL/SPARQL. The course also describes various NoSQL databases (key-value, column, document or graph-oriented databases), as well as various big data formats (Avro, ORC and Parquet). The course explains different data integration approaches: integration according to a materialized view (Data Warehouses/OLAP) and integration according to a virtual view (Mediators/GAV-LAV).

This course also covers Stream, and Batch processing using big data architectures such as Lambda architecture as well as integration and processing pipelines, using appropriate tools such as Talend Big Data Integration Studio, and Azure Data Factory.

020DVCOM3 Data Visualization and Communication 4 Cr.

Access to data is exponentially increasing while human capacity to manage and understand it remains constant. Clearly and effectively communicating about the models found in the data is a key skill for a successful data scientist. This course introduces basic concepts of visualization, analysis, and visual representation of data, necessary for the creation of suitable applications and tools that allow students to manage and analyze big data flows. It involves designing and implementing complementary visual and verbal representations of patterns and analyses to convey results, answer questions, drive decisions, and provide convincing evidence supported by data.

020MADSM2 Marketing Data Science 4 Cr.

This course provides students with foundations in various modeling methodologies commonly used in marketing, including Attribution Modeling, Marketing Mix Modeling (MMM), and other advanced techniques such as Bayesian methods. Through a combination of theoretical lectures, hands-on practical exercises, and real-world case studies, students will develop the skills necessary to analyze marketing data, derive actionable insights, and make data-driven decisions to optimize marketing strategies.

020IAMLM2 Machine Learning and Deep Learning 4 Cr.

This course goes beyond the phase of collecting large volumes of data by focusing on how machine learning algorithms can be rewritten and extended to scale for petabytes of structured and unstructured data. Also, sophisticated models for predictions are included. The course is divided into three main parts.

The first part deals with the design and development of algorithms allowing the behavior of computers to evolve based on empirical data, such as databases or sensory data. We also define supervised, unsupervised and reinforcement learning.

The second part introduces deep learning as well as key network architectures including: convolutional neural networks, autoencoders, recurrent neural networks, long-term short-term networks “LSTM”. This part also covers deep reinforcement learning.
The third part deals with the processing of natural languages. Indeed, research in the automatic processing of natural languages is a field of artificial intelligence aiming at the development of automated techniques for the manipulation of language data, in textual or sound forms. Immediate applications include developing more natural textual interfaces, automatic document translation, spam detection, information retrieval, question-answering systems, among others. This part introduces students to the following subjects: Introduction to the problem of automatic processing of natural language and its applications.

020MMDES4 Mining Massive Data Sets 4 Cr.
This course covers the fundamentals of designing dedicated software systems for big data analytics.
The course begins with principles of designing relational database systems for analyzing business data, including declarative queries, query optimization and transaction management. It also covers the evolution of basic data systems to support complex analytical problems and scientific data management.
The course then explores fundamental architectural changes necessary for processing data beyond the limits of a single computer. This includes parallel databases, “MapReduce”, column storage, distributed key value, and enabling low-latency analytical results from real-time data streams. Finally, this course examines advanced data management systems supporting various data models including tree structure (XML and JSON), structured data graphics (RDF), new workloads such as machine learning tasks (Spark), and mixed workloads (such as Google Cloud Dataflow).

048MBCMM2 Regression Models 4 Cr.
This course covers the fundamentals of regression, including linear regression, its approach, and its applications in practical studies. It also includes ANOVA techniques and logistic regression. The course alternates between theoretical presentations and computer exercises, utilizing the R language.

048DSSBM1 Social Big Data 4 Cr.
This course introduces the structures and data types found on social networks (such as Facebook, Twitter, Instagram, etc.). It covers various methods of data collection and analysis based on application areas under the R language. Students gain proficiency in utilizing different application programming interface services (API) to collect data, analyze and explore social media data for research and development purposes. Ultimately, students will use the data drawn and analyzed to improve their presence and strategy on social networks.

020IABMM3 AI for Business and Marketing 6 Cr.
This course explores the integration of artificial intelligence tools and techniques in business and modern marketing practices. Students will delve into the utilization of AI algorithms, machine learning models, and data analytics to optimize marketing strategies across various

digital channels and business decision-making. Through real-world applications and hands-on experience, students will learn to personalize content, enhance customer engagement, and drive ROI through targeted advertising and dynamic pricing. The course emphasizes ethical considerations and responsible AI usage, empowering businesses to effectively leverage technology while maintaining integrity and trust.

048DSARM3 Applied Regression and Time Series Analysis 4 Cr.
This course introduces the following subjects: Visualization techniques for time series data, key concepts in probability and mathematical statistics, classical linear regression models, variable transformation, model specification, causal inference, variable estimation, autoregressive (AR) instrumental models, moving average, autoregressive moving average (ARMA), integrated average autoregressive (ARIMA), GARCH models, vector autoregression (VAR), statistical forecast, and regression with time series data.

020BDFRM3 Big Data Frameworks 5 Cr.
This course is conceptually divided into two parts.
The first part covers the fundamental concepts of MapReduce parallel computing, focusing on Hadoop, MrJob and Spark. It delves deeply into Spark, data frames, Spark Shell, Spark Streaming, Spark SQL, MLlib. Students use MapReduce for industrial applications and deployments across various fields, including advertising, finance, health, and search engines.
The second part focuses on algorithmic design and development in parallel computing environments (Spark). It covers algorithmic development (learning decision tree), graphics processing algorithms (such as PageRank and short path), Newton algorithms, and support vector machines.

020GAIES5 Generative AI 4 Cr.
Generative AI is a course designed to offer a comprehensive understanding of generative models in AI, like ChatGPT and diffusion models, and the practical application of these technologies. The course emphasizes open-source models, training techniques, and fine-tuning practices.

Specific objectives of the course:

- Understanding the architecture and principles of generative models.
- Learning the process of training and fine-tuning AI models.
- Exploring open-source AI models and their applications.
- Developing hands-on experience in building AI-driven solutions.

020IALPM3 Legal, Political and Ethical Considerations for Data Scientists and AI 4 Cr.
This course introduces ethics, politics, and ethical implications of data, including personal data. It examines the legal, political, and ethical issues that arise throughout the entire lifecycle of the science of data collection, storage, processing, analysis and use, including privacy, surveillance, security, classification and discrimination. Additionally, a brief introduction will be provided about law and Labor law in general. Case studies will be used to explore these issues in various areas such as criminal justice, national security, health, marketing, politics,

education, automotive, employment, athletics, and development. Particular attention will be paid to legal and political constraints and considerations specific to each area.

020IAIDM3 Machine Learning Operations 4 Cr.

By the end of this course, students will have acquired a comprehensive understanding of industrial AI, enabling them to effectively apply AI techniques in real-world industrial settings. They will be equipped with practical skills in MLOps, AI deployment, and XAI, making them valuable contributors to the rapidly evolving field of industrial artificial intelligence. In the final part of the course, students will explore the emerging field of Explainable AI (XAI). They will learn techniques to interpret and explain the decisions made by AI models, with an emphasis on their application in industrial scenarios.

048DSTGM3 Theoretical Guidelines for High-Dimensional Data Analysis 4 Cr.

This course introduces the different types of quantitative research methods and statistical techniques for analyzing data. It starts with an emphasis on measurement, statistical inference and causal inference. Next, it explores a range of statistical techniques and methods using the language of open-source statistics (using R or Python). Different techniques for data analysis and visualization are introduced, with a focus on applying this knowledge to real-world data problems. The techniques included are descriptive and deductive statistics, sampling, experimental design, parametric and non-parametric difference tests, least squares regression, and logistic regression.

020STGEM4 Master Dissertation 30 Cr.

During the last semester, students must complete a professional internship in a company or research work in a laboratory for 4 months.

The internship can take place in Lebanon or abroad. The scientific responsibility for the internship is provided jointly by the company and an instructor from USJ or a partner university. This internship, of a minimum of one semester, aims to develop all the skills necessary in the data science field.

Students can also choose to contribute to an academic research project. It takes place in a laboratory either in Lebanon or in an external institution.

The internship or research work is the subject of a dissertation and a public defense in the presence of USJ professors.

Only students who have validated all the courses of the first year and the first semester of the second year of the Master’s program are authorized to submit their internship report or present their research dissertation.

The dissertation or the report includes a bibliographic part and a technical part.

The evaluation of the internship work considers three elements:

- Evaluation of the trainee’s scientific initiative.
- Evaluation of the report.
- Evaluation of the oral defense.

MASTER IN TELECOMMUNICATIONS, NETWORKS AND SECURITY

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: USJ-CST / Lebanese University Rafic Hariri Campus – Hadath.

Objectives

The Master in Telecommunications, Networks and Security prepares engineers and network and security researchers to navigate the global landscape of telecommunications and security. It equips students with the expertise needed for careers in network and security research, network design, telecommunications systems, network administration, multimedia content transmission, and the future of the Internet. This program also lays a solid foundation for students wishing to pursue doctoral studies (PhD) in these fields.

This inter-university degree, awarded in Lebanon, is supported by the collaboration of reputable institutions, which contribute their academic and scientific resources to the training.

This Master's degree is co-delivered by two faculties from two Lebanese universities: **The Faculty of Engineering** at the Lebanese University and the **Faculty of Engineering and Architecture** at the Saint Joseph University of Beirut. The program is offered jointly under the aegis of the Lebanese Ministry of Education and Higher Education.

Program Learning Outcomes (Competencies)

- Acquire and apply advanced knowledge relevant to the discipline.
- Solve critical issues and demonstrate expertise in key areas.
- Innovate and develop solutions for real-world problems.
- Apply new and diversified theoretical and experimental methods relevant to the discipline.
- Conduct independent, original research and contribute to the advancement of knowledge in the field.
- Communicate effectively in both oral and written forms.

Admission Requirements

This is a Master 2 program. Candidates who have already completed 60 credits in a relevant Master's degree or hold an engineering degree in telecommunications, computer science, networks, or any related fields will receive first-year credits by equivalence.

Program Requirements

120 credits: Required courses (60 credits), divided over 2 semesters of 30 credits each. Courses granted by equivalence (60 credits)

Required Courses (60 Cr.)

Advanced Network Protocols and Services (3 Cr.). Mobile and Cellular Networks (3 Cr.). Cryptography (3 Cr.). Network Modeling (3 Cr.). Optimization for Networks (3 Cr.). Cloud and Application Architectures (3 Cr.). Security in Networks (3 Cr.). Cybersecurity (3 Cr.). Wireless Networks (3 Cr.). Machine Learning for Networks and Cybersecurity (3 Cr.). Master Thesis (30 Cr.).

Suggested Study Plan

Semester 1

Code	Course Name	Credits
MTRS01S1	Advanced Network Protocols and Services	3
MTRS02S1	Mobile and Cellular Networks	3
MTRS03S1	Cryptography	3
MTRS04S1	Network Modeling	3
MTRS05S1	Optimization for Networks	3
MTRS06S1	Cloud and Application Architectures	3
MTRS07S1	Security in Networks	3
MTRS08S1	Cybersecurity	3
MTRS09S1	Wireless Networks	3
MTRS10S1	Machine Learning for Networks and Cybersecurity	3
	Total	**30**

Semester 2

Code	Course Name	Credits
MTRS01S2	Master Thesis	30
	Total	**30**

Course Description

MTRS01S1 Advanced Network Protocols and Services 3 Cr.

This course covers the following topics: Switching, flow and congestion control, error control. Routing protocols (RIP, OSPF, BGP). Addressing and Multipoint Group Management (IGMP). Multipoint routing (DVMRP, PIM). Variants of TCP. Protocols for reliability and congestion control for multipoint. IPv6 evolution. IP mobility. Multihoming and SCTP. Architecture of QoS, IntServ and RSVP, DiffServ, MPLS Service. Quality of service routing, Flow management mechanisms (RED, WFQ, etc.), VoIP.

MTRS06S1 Cloud and Application Architectures 3 Cr.
This course covers the following topics: Cloud Technologies and Services. Cloud Computing, architectures, infrastructures, services, virtualization. Distributed processing and storage. Programming and Application Architectures. Agent and multi-agent systems. Intelligent agents. Peer-to-peer architectures.

MTRS03S1 Cryptography 3 Cr.
This course covers the following topics: Basics of Security Services. History of Cryptography. Symmetric, Asymmetric Algorithms, Hash Functions. Cryptographic Mechanisms and Techniques. Cryptographic Modes. PKCS standards. Envelopes. PKI. Smart Cards. Cryptography and ASN1. Modern (quantum) cryptography. It is conducted in the cryptographic laboratory with the use of Cryptographic Tools to implement symmetric, asymmetric, hash algorithms, cryptographic modes, cryptographic protocols and security devices.

MTRS08S1 Cybersecurity 3 Cr.
This course introduces cybersecurity and covers the following topics: cybersecurity tools and processes, system administration, operating system and database vulnerabilities, types of cyberattacks, cybersecurity risk analysis, and technical recommendations for cybersecurity.

MTRS10S1 Machine Learning for Networks and Cybersecurity 3 Cr.
This course covers the following topics: Machine Learning, data analysis methods. How-tos for networks and cybersecurity, analysis, how ML can be applied to cybersecurity, attack detection, prevention, and more.

MTRS01S2 Master Thesis 30 Cr.
This thesis serves as an introduction to research techniques and represents the synthesis of six months of research conducted in a company, research center, or laboratory.

MTRS02S1 Mobile and Cellular Networks 3 Cr.
This course covers the following topics: Cellular concepts and functions in mobile networks; Standardization and evolution of mobile networks; LTE and 4G networks (LTE-Advanced and LTE-Advanced Pro): services, radio interface, physical and protocol architectures, physical, transport and logical channels, voice in LTE, management of data flows, management of radio resources, management of security and developments from LTE to LTE-Advanced and LTE-Advanced Pro; recent advances in mobile networks; dimensioning and radio planning of 4G networks; mobile network deployment practices; quality of service and optimization of mobile networks; C-RAN; SDN; Cellular Internet of Things.

MTRS04S1 Network Modeling 3 Cr.
This course covers the following topics: Introduction to teletraffic theory. Memoryless source model (Bernoulli and Poisson) and study of multiplexing and multiple access. Discrete-time and continuous-time Markov chains. Introduction to Queuing Theory). Markovian files of type M/M and applications to modeling in networks. Queuing networks. Product form networks. Traffic

and traffic aggregation models. Non-Markovian files (M/G/1 and G/M/1). Problems of performance evaluation and modeling of communication systems. Sizing.

MTRS07S1 Security in Networks 3 Cr.

This course covers the following topics: Network techniques and architectures. Network attacks. Security services and areas. Network security and associated solutions. Tools and equipment (smart cards) for security. Real case studies for network security. Key distribution - PKI - Audit - Components (TPM) - Applications: Ad-hoc networks, RFID, peer-to-peer, electronic directory and messaging, SMIME, etc. Security in fixed and mobile telecom and packet networks (GSM, UMTS, WiMAX).

MTRS05S1 Optimization for Networks 3 Cr.

This course covers the following topics: Mathematical optimization: formulation of an optimization problem, linear optimization problem, convex non-linear optimization problem, integer optimization problem, non-convex non-linear optimization problem. Search for optimal solution: Lagrangian, duality, optimality conditions, complexity, tools and software for optimization.

Algorithms: simplex, branch and bound, gradient and subgradient, primal and dual decomposition, meta-heuristic. Multi-objective optimization: dominance, scalar method, Pareto criterion and utilitarian criterion. Optimization and game theory: non-cooperative games, utility function and optimization, Nash equilibrium, Best Response algorithm. Application of optimization for networks: routing in networks, network sizing, bandwidth allocation and fairness problems, scheduling in wireless networks, power control in wireless networks, selection of wireless access.

MTRS09S1 Wireless Networks 3 Cr.

This course covers the following topics: Classification of wireless networks. WLAN networks: architecture, versions, MAC protocol, QoS. Ad hoc networks: self-configuration, proactive and reactive routing, MAC layer. Vehicular networks: requirements and constraints of intelligent transport systems (ITS), V2I and V2V communications, applications, standards, QoS, mobility models. Sensor networks: WSN architecture, clustering and routing mechanism with energy constraints, low-power communications standards (IEEE 802.15.4, BLE), 6LowPAN and ZigBee. Internet of Things: IoT pillars, IoT elements, IoT applications, communication protocols: MQTT, CoAP, LoRaWAN.

PhD IN CIVIL, WATER AND ENVIRONMENTAL ENGINEERING

Campus Where the Program Is Offered: CST

Objectives

- Prepare students for an advanced, specialized academic level, enabling them to meet current and future challenges in the fields of civil engineering, water and environment.
- Develop skills that help students remain committed and succeed in quality research work.
- Equip students with methods to effectively communicate research results both through publications and oral presentations.
- Train students to pursue academic, leadership or entrepreneurial positions in the fields of civil engineering, water and environment.

Admission Requirements

Candidates must:

- Hold the Lebanese Baccalaureate or its equivalent.
- Hold a Master degree in engineering or its equivalent.
- Ensure consistency between their master's and PhD disciplines.
- Have a minimum average of 12/20 or equivalent required for the master’s degree.

Program Requirements

- Validation of 180 ECTS credits (12 course credits and 168 credits for the preparation of a PhD thesis).
- Maximum duration of 6 years for a full-time thesis (8 years for part-time).
- Publication as first author in peer-reviewed indexed journals or conference proceedings of two scientific papers based on thesis results.
- Participation in the PhD days.
- Write and submit a thesis report.
- Positive assessment from two reviewers.
- Thesis defense before a jury.

PhD IN COMPUTER AND TELECOMMUNICATIONS ENGINEERING

Campus Where the Program Is Offered: CST

Objectives

- Prepare students for an advanced, specialized academic level, enabling them to meet current and future challenges in the fields of computer and communications engineering.
- Develop skills that help students remain committed and succeed in quality research work.
- Equip students with methods to effectively communicate research results both through publications and oral presentations.
- Train students to pursue academic, leadership or entrepreneurial positions in the fields of computer engineering and telecommunications.

Admission Requirements

Candidates must:

- Hold the Lebanese Baccalaureate or its equivalent.
- Hold a Master degree in engineering or its equivalent.
- Ensure consistency between their master's and PhD disciplines.
- Have a minimum average of 12/20 or equivalent required for the master’s degree.

Program Requirements

- Validation of 180 ECTS credits (12 course credits and 168 credits for the preparation of a PhD thesis).
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- Participation in the PhD days.
- Write and submit a thesis report.
- Positive assessment from two reviewers.
- Thesis defense before a jury.

PhD IN ELECTRICAL AND ENERGY ENGINEERING

Campus Where the Program Is Offered: CST

Objectives

- Prepare students for an advanced, specialized academic level, enabling them to meet current and future challenges in the fields of electrical engineering and energy.
- Develop skills that help students remain committed and succeed in quality research work.
- Equip students with methods to effectively communicate research results both through publications and oral presentations.
- Train students to pursue academic, leadership or entrepreneurial positions in the fields of electrical engineering and energy.

Admission Requirements

Candidates must:

- Hold the Lebanese Baccalaureate or its equivalent.
- Hold a Master degree in engineering or its equivalent.
- Ensure consistency between their master's and PhD disciplines.
- Have a minimum average of 12/20 or equivalent required for the master’s degree.

Program Requirements

- Validation of 180 ECTS credits (12 course credits and 168 credits for the preparation of a PhD thesis).
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