School of Engineering of Beirut (ESIB)

History

In 1910, the Rector of the "Académie de Lyon (France)", M. 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 to Lebanon and the Middle East to bring this idea to realization.

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 on November 2, 1914, and the school buildings were requisitioned on November 14. Following the armistice signed on October 30, 1918, on the island of Moudhros, the reopening of the School of Engineering was scheduled.

An agreement signed on January 27, 1919, between the "Lyonnaise Association for the Development Abroad of Higher and Technical Education" and the "Society of Jesus" led to the opening of EFIB on November 10, 1919. The duration of studies was initially extended to three years, and later to four years in 1936.

The model for the School of Engineering of Beirut was undoubtedly the "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 the "Ecole Centrale de Lyon" without an entrance exam. The first Engineering Degree (called "Diplôme" in the French system) was awarded in 1922 to Mr. Gabriel Rezkallah ARACTINGI.

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 Combatant of 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 "Higher 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, and 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), the school moved to its current premises in Mar Roukos in October 1971. New Programs were then planned. Notably, in 1968-1969 and 1972-1973, the school trained Geographic Engineers for the Lebanese Ministry of National Defense.

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

In 1979, the engineering preparatory years (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...), 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 Roukos premises in October 1980.

Since 1993, the normalization of the situation allowed the gradual establishment of postgraduate Programs (Masters 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 Regional Center for Water and Environment, the Lebanese Center for the Study and Research of Construction, the Center for Electrical and Telecommunications Industries, the Center for Computer Science, Modeling and Information Technology and the Center of 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 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's Degree in "Oil and Gas: Exploration, Production and Management", in collaboration with the "Institut Français du Pétrole" (IFP School). This is 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 options in Electromechanical Engineering and Industrial Systems, and the Computer and Communications Engineering (CCE) program with options in Software Engineering and in Telecommunication Networks.

In 2017, a Chemical and Petrochemical Engineering program and a Master's in Data Sciences were created in collaboration with the Faculty of Sciences of Saint Joseph University of Beirut. The Mechanical Engineering (ME) program is the latest addition, having been implemented in 2020.

Mission

The « Ecole Supérieure d'Ingénieurs de Beyrouth » (ESIB) of 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

Honorary deans: Maroun ASMAR, Sélim CATAFAGO, Wajdi NAJEM, Fadi GEARA

Heads of departments and research centers:
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 RAHBANI MOUNSEF
Department of Doctoral Studies: Hadi KANAAN
Center of Electrical and Telecommunications Industries: Elias RACHID
Center of Computer, Modeling and Information Technology: Rayan MINA
Lebanese Center for the Study and Research of Construction: Fouad KADDAH
Regional Center for Water and Environment:

Administrative staff
Dean's office:
Dean's assistant: Ghada AOUAD
Executive assistants: Rose DAGHER MRAD, Tatiana JABBOUR, Elyse SALIBA

Supervisor: Jihad KHAWAND
Employee: Marie EL KHOURY EL HAGE

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 Doctoral Studies:
Executive assistant: Zeina SAWAYA BOUERI

Center of Electrical and Telecommunications Industries:
Head of the Electromechanical Unit: Michel MOUGHABGHAB

Center of Computer, Modelling and Information Technology:
Programmer: Carine BOUSTANY SAWAYA

Lebanese Center for the Study and Research of Construction:
Executive Assistant: Zeina SAWAYA BOUERI
Lab Technician: Charbel AOUN

Regional Center for Water and Environment:
Lab Assistant: Elie KHACHO

Faculty members

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

Associate professors
Ali AL SHAER, Nancy CHALHOUB, Melhem EL HELOU, Rafic FADDOUL, Fares MAALOUF, Chantal MAATOUK, Renalda SAMRA KHALIL (AL), Sami YOUSSEF.

Assistant professors
Alain AJAMI, Cynthia ANDRAOS, Youssef BAKOUNY, Georges CHAMOUN, Marina DACCACHE, Rim DBAISSY, Ali HARKOUS, Farah HOMSI, Joseph KESERWANY, Gabriel EL KHOURY, Rayan MINA, Joanna NSEIR YARED, Jihane RAHBANI, Katia RAYA RAMI, Chantal SAAD HAJJAR, Guilnard SADAKA, Wafa SAOUD, Jean SAWMA, Tina YAACOUB NASSAR.

Lecturers
Juliana EL RAYESS, Maria HABIB, Melissa SAID.

Invited professors
Said BITAR, Claude BOCQUILLON, Maurice FADEL, Hussein IBRAHIM, Eric MONMASSON, Assad ZOUGHAIB.

Faculty members of another institution of USJ
Maher ABBOUD, Nancy ALLAM CHOUCAIR, Nizar ATRISSI, Hayat AZOURI TANNOUS, Joseph BEJJANI, Ursula EL HAGE, Roger LTEIF, Dominique SALAMEH.

Adjuncts

Pascale ABBOUD, Jack ABDO, Joanna ABDOU NADER, Haybat ABDUL SAMAD, Maria ABI KHALIL, Nohra ABI RIZK , Roy ABI ZEID DAOU, Naji ABOU ASSALY, Adel ABOU JAOUDE, Jimmy ABOU JAOUDE, Joanna ABOU JAOUDE, Abdallah ABOU RAHHAL, Marc ABOU RJEILI, Georges ABOU SLEIMAN, Hani AGHAR, Nancy ALAM CHOUCAIR, Elie AOUAD, Angèle AOUAD RIZK, Nathalie AOUAD REHAYEM, Théodore AOUAD, Zeina AOUN GHATTAS, Khattar ASSAF, Ortanse ATTARIAN JABRE, Ahmad AUDI, Soumaya AYADI MAASRI, Maroun AYLI, Rita AYOUB, Jean-Marie BACHA, Georges BACHIR, Hilda BAIRAMIAN, Carine BECHARA, Mounia BEDRAN, Danielle BEDROSSIAN, Nabil BEJJANI, Rana BEJJANI, Nadine BEJJANI, Said BITAR, Elie BOU CHAKRA, Marc BOUJI, Maroun BOULOS, Marleine BRAX, Nathalie CHAHINE, Gérard CHALHOUB, Fida CHAMI (EL) SAYAH (EL), Ralph CHAMMAS, Khaled CHEBAT, Dima CHEBIB, Saïd CHEHAB, Jihad CHERFAN, Samer CHERFANE, André CHKAIBANE, Antoine CHOUEIRY, Esber CHOUEIRY, Nadim CHOUEIRY, Joseph CONSTANTIN, Ibtissam CONSTANTIN KIWAN, Mohammad DAKROUB, Elsie DEEK (EL) ABOU JAOUDE, Toufic FAKHRY Fady FARAH, Joseph FARES, Robert FARHA, Hussein FARROUKH, Antoine FEGHALY, Christelle GEARA, Charbel GEMAYEL, Nada GHORRA CHEHADE, Rémi GHOSN, Roland HABCHI, Bassam HABRE, Georges HADDAD, Roland HADDAD (EL), Ronald HAGE, Antoine HAGE, Ahmad HAJJ, Danielle HAJJ (EL), Patrick HAJJ, Alyda HAJJ NEHMEH, Mario HAJJAR, Wassim HAJJAR, Ziad HAKIM RAHME, Mayyada HAMDANE, Najib HARB, Roy HARB, Khalil HARISS, Joumana HAYEK (EL), Elias HELOU, Rouba HELOU SARKIS, Nabil HENNAOUI, Alaa HIJAZI, Rayan HIJAZI, Josiane HINDI, Elie HLEIHEL, Nelly HOBEIKA, Jihad HOKAYEM (EL), Mary HOKAYEM (EL), Najate HOKAYEM (EL), Antoine HREICHE, Eliane IBRAHIM, Karim ISHAK, Lina ISKANDAR HAWAT, Rami ISMAIL, Sahar ISMAIL, Georges JAMAL, Samar KADDAH, Toni KAHWAJI, André KANAAN, Jean-Michel KAOUKABANI, Hanady KARAM, Marie Reine KARAM, Tony KARAM, Walid KHALIL, Tony KHALIL, Marina KHOURY, Grace KHOURY (EL), Ibrahim KIWAN, Joseph KOZEILY, Nader KOZHAYA, Elie MAALOUF, Youmna MAKHLOUF, Hiam MALLAT, Eliane MATAR ABEDISSIAN, Johny MATAR, Chadi MATNI, Roger MATTA, Rodolphe MATTAR, Joseph MCHAYLEH, Hassan MCHEIK, Ziad MELHEM, Rabih MOAWAD, Ammar MOHANNA, Abbas MOURAD, Alfred MORCOS HAYEK, Fouad MOTI, Carole MOUKAWAM DIB, Manal MOUSSALLEM, Marc NADER, Nassib NASR, Bassel NASR, Bassam NASRALLAH, Danielle NASRALLAH, Rana NASSIF, Salim NASSREDDINE, Georges NAWFAL, Hiam NEHME, Elie RAHME, Elie RENNO, Bassam RIACHI, Majdi RICHA, Alexandre RICHA, Despina RIZK, Dina RIZK, Nicolas ROUHANA, Nour ROUMIEH, Kamal SAFA, Jean SAMAHA, Abdellatif SAMHAT, Nour SARDOUK, Maria SAROUFIM, Joseph Mary SARROUH, Antoine SAWAYA, Antonio SAWAYA, Graziella SEBAALY, Vahe SEFERIAN, Marlène SEIF AOUAD, Chadi SFEIR, Saad SFEIR, Carla TABBOUNY, Hugues TALBOT, Anthony TANNOURY, Fadia TAWIL KARAM, Mansour TAWK, Martine TOHME, Mohammad TOHME, Youssef TOHME, Naji WAK, Jean-Yves YOUSSEF, Christiana ZARAKET, Elie ZEIDAN, Elise ZGHEIB.

Degrees awarded

- Bachelor of Engineering – Major Chemical and Petrochemical Engineering
- Bachelor of Engineering – Major Civil Engineering. Options:
  - Buildings and Engineering Management
  - Public Works and Transportation
  - Water and Environment
- Bachelor of Engineering – Major Computer and Communications Engineering. Options:
  - Software Engineering
  - Telecommunication Networks
- Bachelor of Engineering – Major Electrical Engineering
- Bachelor of Engineering – Major Mechanical Engineering
- Master in Artificial Intelligence
- Master in Data Sciences
- Master in Electrical Engineering
- Master in Oil and Gas: Exploration, Production and Management
- Master in Renewable Energies
- Master in Road Safety Management
- Master in Structures and Soil Mechanics
- Master in Telecommunications, Networks and Security
- Master in Water Sciences
- PhD in Civil Engineering, Water and Environment
- PhD in Computer Engineering and Telecommunications

- PhD in Electrical and Energy Engineering

Outcome

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

- Consulting firms and design offices
- Companies in the banking and insurance sector
- Companies in the home automation sector
- Companies in the robotics sector
- Electrical networks: production, conversion, transport and distribution of electrical energy
- Electrification
- Industry
- Management
- Teaching and research
- Technological startups

Bachelor of Engineering – Major 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. As an indication, in the first semester of the year 2023-2024, tuition fees amount to $268 per credit in preparatory engineering courses and major engineering courses, or $8,040 for 30 credits. 60% of the tuition is paid in fresh Dollars and 40% in Lebanese Pounds at 40% Sayrafa rate or to the parallel market for one American dollar. To address their financial difficulties, students contact the Social Services at Saint Joseph University of Beirut. If their application is accepted, they may receive a study grant or a loan. To download the social application form, visit: www.usj.edu.lb/servicesocial/.

Department of Preparatory Classes

Honors Preparatory Chemical and Petrochemical Engineering (CPE)

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 graduate students able 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (120 credits)
USJ General Education Program (12 credits – 26 additional credits are earned at the Department of Chemical and Petrochemical Engineering)

USJ General Education Program (12 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Quantitative Research Techniques (6 Cr.)
- Discrete Mathematics (6 Cr.)

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 (8 Cr.)
- Geology (2 Cr.)
- Introduction to Engineering Projects (2 Cr.)
- Introduction to Fluid Mechanics (2 Cr.)
- Supervised Personal Initiative Work (2 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 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
020PIICI4	Introduction to Engineering Projects	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
	Total	**26**

Honors Preparatory Civil Engineering (CE)

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The objectives of the Civil Engineering program are to graduate students able 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (120 credits)
USJ General Education Program (12 credits – 30 additional credits are earned at the Department of Civil Engineering and Environment)

USJ General Education Program (12 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Quantitative Research Techniques (6 Cr.)
- Discrete Mathematics (6 Cr.)

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 (10 Cr.)
Introduction to Engineering Projects (2 Cr.)
Geology (2 Cr.), Statics (2 Cr.)
Supervised Personal Initiative Work (2 Cr.)
Topography (2 Cr.)
Humanities (6 Cr.)
Engineering at the Service of the Community (2 Cr.)
French and Philosophy 1 (2 Cr.)
French and Philosophy 2 (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 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
020IMFCI4	Introduction to Fluid Mechanics	2
020PIICI4	Introduction to Engineering Projects	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
	Total	**26**

Honors Preparatory Computer and Communications Engineering (CCE)

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 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (120 credits)
USJ General Education Program (12 credits – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (12 Cr.)

- Humanities (6 Cr.)
  - Engineering at the Service of the Community (2 Cr.)
  - French and Philosophy 1 (2 Cr.)
  - French and Philosophy 2 (2 Cr.)
- Quantitative Research Techniques (6 Cr.)
  - Discrete Mathematics (6 Cr.)

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 (14 Cr.)
  - Digital Systems Design (4 Cr.)
  - Introduction to Engineering Projects (2 Cr.)
  - Linear Electrical Systems and Networks (4 Cr.)
  - Signal Processing (2 Cr.)
  - Supervised Personal Initiative Work (2 Cr.)
- Humanities (6 Cr.)
  - Engineering at the Service of the Community (2 Cr.)
  - French and Philosophy 1 (2 Cr.)
  - French and Philosophy 2 (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 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
020PIICI4	Introduction to Engineering Projects	2
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

	Total	**26**

Honors Preparatory Electrical Engineering (EE)

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The objectives of the Electrical 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (120 credits)
USJ General Education Program (12 credits – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (12 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Quantitative Research Techniques (6 Cr.)
- Discrete Mathematics (6 Cr.)

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 (12 Cr.)
- Digital Systems Design (4 Cr.)
- Introduction to Engineering Projects (2 Cr.)
- Linear Electrical Systems and Networks (4 Cr.)
- Supervised Personal Initiative Work (2 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 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
020PIICI4	Introduction to Engineering Projects	2
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
	Total	**26**

Honors Preparatory Industrial Engineering (IE)

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The objectives of the Industrial 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (120 credits)
USJ General Education Program (12 credits – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (12 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Quantitative Research Techniques (6 Cr.)
- Discrete Mathematics (6 Cr.)

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 (12 Cr.)
- Digital Systems Design (4 Cr.)
- Introduction to Engineering Projects (2 Cr.)
- Linear Electrical Systems and Networks (4 Cr.)
- Supervised Personal Initiative Work (2 Cr.)

Humanities (6 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- French and Philosophy 1 (2 Cr.)
- French and Philosophy 2 (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 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
020PIICI4	Introduction to Engineering Projects	2
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
	Total	**26**

Honors Preparatory Mechanical Engineering (ME)

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus Where the Program Is Offered: CST

Objectives

The objectives of the Mechanical 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (120 credits)
USJ General Education Program (12 credits – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (12 Cr.)

Humanities (6 Cr.)

Engineering at the Service of the Community (2 Cr.)

French and Philosophy 1 (2 Cr.)

French and Philosophy 2 (2 Cr.)
Quantitative Research Techniques (6 Cr.)
Discrete Mathematics (6 Cr.)

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 (12 Cr.)
Computer Assisted Drawing (2 Cr.)
Introduction to Engineering Projects (2 Cr.)
Linear Electrical Systems and Networks (4 Cr.)
Statics for Mechanical Engineering (2 Cr.)
Supervised Personal Initiative Work (2 Cr.)
Humanities (6 Cr.)
Engineering at the Service of the Community (2 Cr.)
French and Philosophy 1 (2 Cr.)
French and Philosophy 2 (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4

020MC1CI1	Mechanics 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
020DISCI4	Computer Assisted Drawing	2
020PIICI4	Introduction to Engineering Projects	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
	Total	**26**

Honors Preparatory 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) and 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)

020DISCI4 Computer Assisted Drawing 2 Cr.
Drawing on AutoCAD. Classification of drawings. Standardization. Presentation of drawings. Methods of executing a drawing. Geometric constructions. Connections. Common curves. Presentation of solids. Dimensioning. Cross-sections. Sections. Surface states. Tolerances and fits. Functional dimensioning. Assembly drawing. Modes of mechanical connections. Means of mechanical connections and technological elements. Symbolic representation.

020TEDCI4 Digital Systems Design 4 Cr.
This course provides students with the opportunity to familiarize themselves with various methods of designing simple digital systems. They will learn how to decompose a function into combinational and sequential blocks, and discover techniques for automating industrial processes based on specifications. The course content covers essential concepts such as number systems and codes, combinational and sequential logic, logical functions, and integrated logic circuits. Students will also explore topics

including the Morgan's theorem, Karnaugh maps, flip-flops, synchronous and asynchronous binary counters/decoders, and shift registers. Practical work will be conducted to apply these concepts.

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

020EMECI3 Electromagnetism 4 Cr.
This course starts with a separate study in the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is 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) and General Analysis (020ANGCI1)

020GSCCI1 Engineering at the Service of the Community 2 Cr.
This course aims to explore the role of engineers in modern society, with a particular focus on innovation, renewable energies, green buildings, design, food security, recycling, and other areas relevant to our daily lives. Students will learn how engineers can leverage their technical skills, knowledge, and tools to address and solve social and environmental challenges through engineering.

020FR1CI2 French and Philosophy 1 2 Cr.
This course prepares first-year students for the written French exam at École Polytechnique admission exam (Filière Universitaire Internationale - Formation Francophone, FUI-FF). Its objective is to provide students with the academic and didactic tools necessary for success in this admission exam.

020FR2CI3 French and Philosophy 2 2 Cr.
This course prepares second-year students for the written French exam at École Polytechnique admission exam (Filière Universitaire Internationale - Formation Francophone, FUI-FF). Its objective is to provide students with the academic and didactic tools necessary for success in this admission exam.

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

020CHGCI1 General Chemistry 4 Cr.
This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students also learn the concept of heterogeneous equilibrium in 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.

020PIICI4 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.

020IMFCI4 Introduction to Fluid Mechanics 2 Cr.

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

020SRLCI4 Linear Electrical Systems and Networks 4 Cr.

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

020INMCI2 Magnetic Induction 2 Cr.

This course is new 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, wavelength, light spectrum, numerical signal, travelling wave, diffraction, interferences, Doppler effect, Newton's law, mechanical energy, harmonic oscillator. It assures a smooth transition toward a more quantitative physics than the one seen at high school.

020PP1CI2 Physics Laboratory 1 2 Cr.

This practical work course is designed to bridge the gap between theoretical knowledge and practical application in the field of electrical engineering and physics. Throughout the course, students will engage in hands-on activities to gain a deeper understanding of various concepts. The key topics covered include resonance in RLC Circuits, system analysis, circuit measurements, mechanics and motion, LabVIEW Software, fields and characteristics, oscilloscope applications, Single-Degree-of-Freedom Oscillator, 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 pulsograph (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)

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)

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)

020TOGCI4 Topography 2 Cr.

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

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 Chemical and Petrochemical Engineering (CPE)

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 graduate students able 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 – 26 additional credits are earned at the Department of Chemical and Petrochemical Engineering)

USJ General Education Program (10 Cr.)

Humanities (4 Cr.)
Engineering at the Service of the Community (2 Cr.)
Religions in Their Diversity (2 Cr.)
Quantitative Research Techniques (6 Cr.)
Discrete Mathematics (6 Cr.)

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.)
  - Supplemental 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.)
  - Religions in Their Diversity (2 Cr.)

Open Elective Courses (4 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADNI1	Discrete Mathematics	6
020GSCNI1	Engineering at the Service of the Community	2
020ANGNI1	General Analysis	6
020CHGNI1	General Chemistry	4
020MC1NI1	Mechanics 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
018RDLDL1	Religions in Their Diversity	2
020TH2NI3	Thermodynamics 2	4
	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**

Regular Preparatory Civil Engineering (CE)

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 graduate students able 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 – 30 additional credits are earned at the Department of Civil Engineering and Environment)

USJ General Education Program (10 Cr.)

Humanities (4 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- Religions in Their Diversity (2 Cr.)

Quantitative Research Techniques (6 Cr.)
- Discrete Mathematics (6 Cr.)

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.)
- Supplemental 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 1 (4 Cr.)
- Programming 2 (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.)
- Religions in Their Diversity (2 Cr.)

Open Elective Courses (4 Cr.)

Suggested Study Plan

Semester 1

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

Semester 2

Code	Course Name	Credits
020AA1NI2	Analysis 1	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
018RDLDL1	Religions in Their Diversity	2
020TH2NI3	Thermodynamics 2	4
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**

Regular Preparatory Computer and Communications Engineering (CCE)

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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (10 Cr.)

- Humanities (4 Cr.)
  - Engineering at the Service of the Community (2 Cr.)
  - Religions in Their Diversity (2 Cr.)
- Quantitative Research Techniques (6 Cr.)
  - Discrete Mathematics (6 Cr.)

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.)
  - Supplemental 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.)
  - Religions in Their Diversity (2 Cr.)

Open Elective Courses (4 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADNI1	Discrete Mathematics	6
020GSCNI1	Engineering at the Service of the Community	2
020ANGNI1	General Analysis	6
020CHGNI1	General Chemistry	4
020MC1NI1	Mechanics 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
020MC2NI3	Mechanics 2	4
020PP2NI3	Physics Laboratory 2	2
020PRBNI4	Probability	4
020IF2NI3	Programming 2	4
020OPTNI3	Wave Optics	2
	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
018RDLDL1	Religions in Their Diversity	2
	Open Elective	2
	Total	**30**

Regular Preparatory Electrical Engineering (EE)

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 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (10 Cr.)

Humanities (4 Cr.)
- Engineering at the Service of the Community (2 Cr.)
- Religions in Their Diversity (2 Cr.)

Quantitative Research Techniques (6 Cr.)
- Discrete Mathematics (6 Cr.)

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.)
- Supplemental 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.)
- Religions in Their Diversity (2 Cr.)

Open Elective Courses (4 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADNI1	Discrete Mathematics	6
020GSCNI1	Engineering at the Service of the Community	2
020ANGNI1	General Analysis	6
020CHGNI1	General Chemistry	4
020MC1NI1	Mechanics 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
018RDLDL1	Religions in Their Diversity	2
	Open Elective	2
	Total	**30**

Regular Preparatory Industrial Engineering (IE)

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 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (10 Cr.)

- Humanities (4 Cr.)
  - Engineering at the Service of the Community (2 Cr.)
  - Religions in Their Diversity (2 Cr.)
- Quantitative Research Techniques (6 Cr.)
  - Discrete Mathematics (6 Cr.)

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.)
  - Supplemental 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.)
  - Religions in Their Diversity (2 Cr.)

Open Elective Courses (4 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits
020MADNI1	Discrete Mathematics	6
020GSCNI1	Engineering at the Service of the Community	2
020ANGNI1	General Analysis	6
020CHGNI1	General Chemistry	4

020MC1NI1	Mechanics 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**
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
018RDLDL1	Religions in Their Diversity	2
	Open Elective	2
	Total	**30**

Regular Preparatory Mechanical Engineering (ME)

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 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 – 26 additional credits are earned at the Department of Electrical and Mechanical Engineering)

USJ General Education Program (10 Cr.)

- Humanities (4 Cr.)
  - Engineering at the Service of the Community (2 Cr.)
  - Religions in Their Diversity (2 Cr.)
- Quantitative Research Techniques (6 Cr.)
  - Discrete Mathematics (6 Cr.)

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.)
  - Supplemental 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.)
- Religions in Their Diversity (2 Cr.)

Open Elective Courses (4 Cr.)

Suggested Study Plan

Semester 1

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

Semester 2

Code	Course Name	Credits
020AA1NI2	Analysis 1	4
020ISMNI2	Introduction to Materials Science	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
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
020PIINI4	Introduction to Engineering Projects	2
020SRLNI4	Linear Electrical Systems and Networks	6
020MATNI4	Matlab	2
020IF3NI4	Programming 3	4
018RDLDL1	Religions in Their Diversity	2
020STMNI4	Statics for Mechanical Engineering	2
	Open Elective	2
	Total	**30**

Regular Preparatory 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 applying these concepts in solving problems related to orthonormalization. Furthermore, the course covers the study of planar isometries, encompassing translations, rotations and reflections, as well as isometries in space. By engaging with these topics, students will acquire a strong foundation in bilinear algebra and the necessary skills to apply these concepts effectively in practical situations.
Prerequisite: Linear Algebra (020ALNNI2)

020BIMNI4 Building Information Modeling 2 Cr.
This course enables the civil engineering students to get to know the notion of BIM (Building Information Modeling), its impact on the construction industry through the software « Revit Structural » from Autodesk. the initiation to BIM will be carried out through multiple examples, exercises reaching the level of being able to create a 3D model.

020DAINI4 Computer Assisted Drawing 4 Cr.
This course empowers civil engineering students with the skills to proficiently utilize Autodesk's AutoCAD software. Throughout the course, students will actively engage in hands-on exercises focused on civil drawings, structural elements, rebar placement, and the layout of apartments and building sections. The course structure is designed to progressively guide students through key concepts, beginning with an introduction to Computer-Aided Design (CAD), covering the graphical interface, and essential commands such as Line, Erase, Copy, Move, and Rotate. The aim of this course is to provide students with a solid foundation in using AutoCAD, a widely adopted software within the civil engineering community. This knowledge will empower them to contribute effectively to the field by producing accurate and professional engineering drawings.

020DAMNI4 Computer Assisted Drawing 4 Cr.
Drawing on AutoCAD. Classification of drawings. Standardization. Presentation of drawings. Methods of executing a drawing. Geometric constructions. Connections. Common curves. Presentation of solids. Dimensioning. Cross-sections. Sections. Surface states. Tolerances and fits. Functional dimensioning. Assembly drawing. Modes of mechanical connections. Means of mechanical connections and technological elements. Symbolic representation.

020COANI4 Computer-Aided Design 4 Cr.
This course is intended for chemical and petrochemical engineering students who are using Aspen HYSYS® for the first time. It will introduce them to process simulation and optimization and will familiarize them to 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, the 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 focused on the propagation of EM waves in vacuum.

Prerequisites: General Analysis (020ANGNI1) and Physical Signals (020SPHNI1)

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

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

020CIFNI4 Fluid Kinematics 2 Cr.

This course introduces the fundamental principles of fluid kinematics. It explores the motion and deformation of fluids without focusing on the forces that produce them. Topics covered include mathematical descriptions of fluid motion, streamlines, particle trajectories, velocity fields, deformation, and potential flows. The course emphasizes 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, the 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 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.

020TCGNI2 General Chemistry Laboratory 2 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students also learn the concept of heterogeneous equilibrium in 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.
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, extensive and compressional. It also presents the different types of rocks, their genesis context, their physical properties and their organoleptic classification.

020STFNI2 Hydrostatics 2 Cr.

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

020CITNI4 Inorganic Chemistry and Laboratory 4 Cr.

This course allows students to acquire solid skills in the field of crystallography: compact and pseudo-compact stacking of metals, interstitial sites, metallic alloys, and metallic bonds. In addition, this course allows to master basic notions on ionic solids through

examples as well as on the solubility of a solid in binary systems through equilibrium diagrams. In addition, part of this course will be dedicated to the study of the physical and chemical properties of certain chemical elements. This course 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.

020IMFNI4 Introduction to Fluid Mechanics 2 Cr.

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

020PIINI4 Introduction to Engineering Projects 2 Cr.

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

020ITCNI3 Introduction to Heat Transfer 2 Cr.

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

020ISMNI2 Introduction to Materials Science 2 Cr.

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

020CIHNI4 Kinetics of Chemical Reactions 2 Cr.

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

020ALNNI2 Linear Algebra 8 Cr.

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

020SRLNI4 Linear Electrical Systems and Networks 6 Cr.

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

Prerequisite: Physical signals (020SPHNI1)

020INMNI2 Magnetic Induction 2 Cr.

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

020MATNI4 Matlab 2 Cr.

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

020MC1NI1 Mechanics 1 4 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.

La 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.

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 pulsograph (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 will be introduced to various aspects of probability, beginning with combinatorics. They will learn techniques such as combinations, permutations and arrangements. Furthermore, they will explore concepts that enhance the understanding and manipulation of probabilities on a countable set. This includes the monotone convergence theorem, Boole's inequality, conditioning, compound probabilities, total probabilities and Bayes' formula. Additionally, the course will emphasize 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, and a brief overview on recursive structures.

Prerequisite: Programming 1 (020IF1NI2)

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)

018RDLDL1 Religions in Their Diversity 2 Cr.

This course is an overview of the three monotheistic religions, namely Judaism, Christianity, and Islam. For each one, we will first examine its history: the cultural and geographical context, its formation, and its expansion. Then, we will study its main foundational texts. Finally, we will attempt a brief analysis of the theology of each.

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)

020STMNI4 Statics for Mechanical Engineering 2 Cr.

Statics is an introduction to learning and applying the principles required to solve engineering problems. Concepts will be applied in this course from previous courses taken in basic math and physics. The course addresses the modeling and analysis of static equilibrium problems with an emphasis on real world engineering applications and problem solving. The purpose of this course is to study methods for quantifying the forces between bodies and defining their equilibrium. Forces are responsible for maintaining balance and causing motion of bodies, or changes in their shape. Motion and changes in shape are critical to the functionality of objects and structure. Statics is an essential prerequisite for many branches of engineering, such as civil engineering and mechanical engineering, which address the various consequences of forces.
Prerequisite: Mechanics 1 (020MC1NI1))

020CMTNI1 Supplemental Mathematics 2 Cr.

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

020TH1NI2 Thermodynamics 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. 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 or cylindrical geometry.
Prerequisite: Thermodynamics 1 (020TH1NI2)

0209TOGNI4 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.

020OPTNI3 Wave Optics 2 Cr.

This course covers the key concepts of the wave theory of light. It begins with the definition of spherical and plane waves, accompanied by a comprehensive exploration of key principles associated with them, such as optical path length, wave intensity, wavefront, wave trains, and coherence length. Special attention is given to light interference through wavefront division (Young's double-slit experiment). The impact of extended and narrow-spectrum light sources is also examined.
Prerequisite: Physical Signals (020SPHNI1)

020PHONI3 Wave Physics 4 Cr.

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

Department of Chemical and Petrochemical Engineering

Chemical and Petrochemical Engineering

Main Language of Instruction:

French: ◙	English: □	Arabic: □

Campus where the program is offered: CST

Objectives

The Chemical and Petrochemical Engineering program aims to graduate students able 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

- Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- Apply engineering design methods to produce solutions that meet specified needs, considering public health, safety, welfare, and global, cultural, social, environmental, and economic factors.
- Communicate effectively with diverse audiences.
- 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.
- Function effectively in a team whose members collectively provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and achieve objectives.
- Develop and conduct appropriate experiments, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed using appropriate learning strategies.

Program Requirements

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

USJ General Education Program (26 Cr.)

At least 10 additional credits are earned at the Department of Preparatory Classes

English (4 Cr.)

English Level A (4 Cr.)

Arabic (4 Cr.)

Open elective: Arabic Culture and Language (2 Cr.)

Business Law (2 Cr.)

Humanities (4 Cr.)

Engineering Ethics (4 Cr.)

4 credits are earned at the Preparatory Classes Department

Social Sciences (6 Cr.)

One restricted elective: Entrepreneurship (2 Cr.) or Work Ready Now (2 Cr.)

Production Management (2 Cr.)

Project Management (2 Cr.)

Communication Techniques (8 Cr.)

Communication Skills (2 Cr.)

Process Design Project (2 out of the 6 credits of the course)

Final Year Project (4 out of the 16 credits of the course)

Quantitative Techniques

6 credits are earned at the Preparatory Classes Department

Fundamental courses

Required Courses (152 Cr.)

Bioreactors and Fermentation Lab (2 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.)
Final Year Project (16 Cr.)
Fluid mechanics (4 Cr.)
Formulation processes (4 Cr.)
Ideal and Non-ideal Reactors (2 Cr.)
Industrial Chemistry (4 Cr.)
Internship (2 Cr.)
Internship 2 (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 (2 Cr.)
Total synthesis and activation methods (4 Cr.)
Unit Operations: adsorption, drying, crystallization (4 Cr.)

Restricted Elective Courses (24 Cr.)

Six courses to choose from the list below

Biochemical techniques and instrumentation (4 Cr.)
Composite materials (4 Cr.)
Design and construction of wells (4 Cr.)
Drilling technology (4 Cr.)
Food Manufacturing and management (4 Cr.)
Microbiology-enzymatic catalysis (4 Cr.)
Pharmaceutical process design (4 Cr.)
Reservoir engineering (4 Cr.)

Solid and hazardous waste management
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.)
Work Ready Now (2 Cr.)

Open Elective Course

Arabic Culture and Language (2 Cr.)

Suggested Study Plan

Semester1

Code	Course Name	Credits
020CCHCS1	Chemical Kinetics/Heterogeneous Catalysis	2 Cr.
020THCCS1	Chemical Thermodynamics	4 Cr.
020CHPCS1	Chemistry of Polymers	4 Cr.
020ETHCS1	Engineering Ethics	4 Cr.
020BRICS1	Mass and Energy Balances	6 Cr.
020ANNCS1	Numerical Analysis	4 Cr.
020IBDCS1	Programming and Databases	4 Cr.
020CHTCS1	Theoretical Chemistry	4 Cr.
	Total	**32 Cr.**

Semester 2

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

Semester 3

Code	Course Name	Credits
020CONCS3	Contactors: systems G-L, F-S, L-L	4 Cr.
020DCPCS3	Dynamics and Process Control	4 Cr.
020ST1CS3	Internship (S2-S3)	2 Cr.
020MOSCS3	Modeling and Simulation	2 Cr.
020PRPCS3	Refining Processes	6 Cr.
020TESCS3	Separation Techniques	6 Cr.

020GTHCS3	Thermal Engineering	2 Cr.
020OPUCS3	Unit Operations: adsorption, drying, crystallization	4 Cr.
	Restricted Elective	4 Cr.
	Total	**34 Cr.**

Semester 4

Code	**Course Name**	**Credits**
020BRFCS4	Bioreactors and Fermentation Lab	4 Cr.
020ANGCS4	English	2 Cr.
020TMCCS4	Mathematical Techniques in Chemical Engineering	6 Cr.
020AMTCS4	Mechanical Agitation and Transfer	2 Cr.
020PPCCS4	Petrochemical Processes	4 Cr.
020PDPCS4	Process Design Project	6 Cr.
020CEPCS4	Process Equipment Design	4 Cr.
020GEPCS4	Production Management	2 Cr.
	Restricted Elective: General Education	2 Cr.
	Total	**32 Cr.**

Semester 5

Code	**Course Name**	**Credits**
020GEACS5	Energy Management Applied to Processes and Utilities	2 Cr.
020PFOCS5	Formulation Processes	4 Cr.
020ST2CS5	Internship 2	2 Cr.
020GEPCS5	Process Engineering Lab	2 Cr.
020GPRCS5	Project Management	2 Cr.
	Restricted Electives	20 Cr.
	Total	**32 Cr.**

Semester 6

Code	**Course Name**	**Credits**
020PFECS6	Final Year Project	16 Cr.
	Total	**16 Cr.**

Course Description

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.

Prerequisite: None

020BRFCS4 Bioreactors and Fermentation Lab 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 fermentations. Fermentation practical work.

Prerequisite: None.

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/Hetergeneous 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.

Chapter I - Reminders of the concepts; Chapter II - Perfect systems; Chapter III - Principle of the study of balances - The variance; Chapter IV - Binary solutions – Raoult and Henry; Chapter V – Thermodynamics stability- Liquid binary system - stability with respect to diffusion - Liquid-liquid transition or demixing; Chapter VI- The model of MSR regular solutions: Chapter VII Fractional distillation; Chapter VIII - Azeotropic mixtures and their mode of separation; Chapter IX – Completely or partially immiscible solid liquid mixtures Eutectics

Prerequisite: Thermodynamics 2 (020TH2NI3)

020CHPCS2 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 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 ways of communication (written, verbal and non-verbal) and making them aware of the errors to be avoided.

020MACCS4 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) - Polymer Chemistry (020CHPCS1)

020CONCS3 Contactors: systems G-L, F-S, L-L 4 Cr.

Gas-liquid contactor technology: case of tray and packed columns. Sizing of technologies to implement them in gas-liquid separation columns in countercurrent. Description of industrial contactors (individualized stage contactors, differential contactors). Criteria for selecting devices. Overview: classification of fluid-solid contactors, applications, advantages, and disadvantages. Characterization of divided solids (grain scale, particle bed): porosities, densities, compressibility of a powder, specific surfaces, equivalent diameters and shape factor, particle size distribution and mean diameter, cohesiveness and flowability of a powder. Flow through fixed beds: radius and hydraulic diameter, Darcy's law, Kozemy-Carman relation, Ergun relation. Fluidized bed contactor: general presentation, different hydrodynamic regimes, powder classification, fluidization limits, expansion of fluidized beds, bubbling phenomena, technology (distributor calculation, cyclone calculation, TDH calculation), heat transfer, application examples.

Prerequisite: Mass Transfer (020PDTCS2)

020CPRCS5 Design and Construction of Wells 4 Cr.

This course is the second course in oil and gas well drilling that the student takes. 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)

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 potentials. 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.

020ENPCS2 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 understand business issues analytically 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.

020MEFCS2 Fluid Mechanics 4 Cr.

Fluid statics. Conservation of mass, momentum, and energy. Dynamics of ideal fluids. Potential flow theory. Dimensional analysis and similarity. Viscous fluid flow.
Prerequisite: Introduction to Fluid Mechanics (020IMFNI4)

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.

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020PFOCS5 Formulation Processes 4 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.

020PFECS6 Final Year Project 16 Cr.

The final year project is carried out by 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)

020RNICS2 Ideal and Non-Ideal Reactors 2 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.

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.

020BRICS1 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 2 (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.
Types of bioreactors - Stirred aerated reactor: hydrodynamic constraints. Modeling and extrapolation 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 2 (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 (020PPCCS4)

020CPPCS4 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.

020CEPCS3 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 3 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 Laboratory" course offers an exploration of three fundamental methods used in industry for the efficient separation of dissolved or suspended substances within complex mixtures. These techniques include liquid-liquid extraction, absorption, 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 2 (020IF2NI3)

020GPRCS5 Project Management 2 Cr.

Definition of a project. Phasing. Milestone organization. Definition of roles of different actors (sponsor, contractor, implementation). Clarification of objectives. Project breakdown (products, activities, costs, responsibilities). Planning approach. Planning methods. Resource allocation. Joint cost allocation-control. Costs, deadlines, quality, task evaluation, before, during, after, lessons learned.

020QHSCS2 Quality, Hygiene, 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.

hysicochemical 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 Managment 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.
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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 will focus on verifying the assumptions required by each statistical test used (normality, equality of variances, etc.). It will use 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 1 2 Cr.

This internship lasts between 2 and 4 weeks in a university or industrial laboratory.

020ST2CS5 Summer Internship 2 (S4-S5) 2 Cr.
This internship lasts between 6 and 8 weeks in the chemical industry.

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 2 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).
Prerequisite: Thermodynamics 2 (020TH2NI3)

020STMCS2 Total Synthesis and Activation Methods 4 Cr.
Total synthesis. Industrial alternatives. Synthesis planning. Retro synthesis techniques. Solutions to chemoselectivity problems. Protection of functional groups and applications. Enantiomer splitting techniques. Asymmetric induction. Prediction of the stereochemistry of products from diastereoselective reactions. Asymmetric synthesis strategies. Enzymatic engineering and industrial asymmetric synthesis. Fields of synthetic chemistry. Profile of synthetic chemistry companies. Accessibility of starting substrates. Sources of organic compounds, SynGas. Production of basic compounds. REACH regulation and procedures to follow. Green chemistry and engineering. Parameters for evaluating the "green" character of a chemical process. Bioprocesses and biotechnologies. Green alternatives to conventional solvents. Principle of electrosynthesis. Advantages and disadvantages of electrosynthesis. Different types of electrosynthesis. Electro-catalytic reactions. Principle of sonochemistry. Constraints and limitations of sonochemistry. Transducers and industrial-scale sonochemistry. Principle of microwave activation. Microwave activation and dielectric properties of materials. Microwave heating and conventional thermal heating. Microwave effects. Multi-step synthesis practical work.
Prerequisite: Organic Chemistry (020CORNI3)

020MLTCS3 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 (+Lab) 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 3-Versatile reactor
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 hire.

Department of Civil Engineering and Environment

Civil Engineering

Main language of instruction:

French: ◙	English: □	Arabic: □

Campus where the program is offered: CST

Objectives

The Civil Engineering Program aims to form design and construction engineers of high scientific and technical level, operational in the fields of civil engineering, buildings and engineering structures, public works and transport, water and the environment and having a global and multidisciplinary approach to projects and their management
The Civil Engineering program aims to graduate students able 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, thanks to trilingual skills, continuous learning, and creativity.
- Lead in a dynamic professional environment through continuous education and the development of knowledge and skills.

Student Outcomes

The student outcomes are aligned with the ABET requirements:

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (132 credits), Program Option Courses (42 credits), Restricted Electives (2 credits), Open Electives (4 credits).
USJ General Education Program (30 credits – part of the above categories)

USJ General Education Program (30 Cr.)

At least 10 additional credits are earned at the Department of Preparatory Classes
English (4 Cr.)
English level A (4 Cr.)
Arabic (4 Cr.)
Arabic language and culture (2 Cr.)
اللغة العربيّة في الصحافة والإعلان (2 Cr.)
Courses taught in Arabic (2 Cr.)
Building Rules and Regulations (2 Cr.)
Humanities (4 Cr.)
Ethics and Engineering (4 Cr.)
Social sciences (6 Cr.)
Building Rules and Regulations (2 Cr.)

General Economics (2 Cr.)
General and Analytical Accounting (2 Cr.)
Communication techniques (8 Cr.)
Final Year Project (4 Cr. directly linked to communication techniques out of the 16 credits of the course).
Building project: Foundation and Structures (2 Cr. directly linked to communication techniques out of the 6 Cr. of the course)
Communication (2 Cr.)
Quantitative techniques (4 Cr.)
Statistics (4 Cr.)

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 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 of the Department of Civil Engineering and Environment. 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: structural drawings, foundations design, etc. (6 Cr.)
- A Final Year Project: This project has a duration of 4 months and is done in groups of 3 to 5 students. The purpose of this project is to put students in a real context of a design office and to ask them to establish a concept, analyze and design a civil engineering structure with a number of 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.)
Wastewater Distribution Networks (2 Cr.)
Solid Waste Management (2 Cr.)
Statistical Hydrology (4 Cr.)
Water Distribution Networks (4 Cr.)
Water and Wastewater Treatment (4 Cr.)

Option Public Works and Transport

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.)

Restricted Elective Civil Engineering Course (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 Arab language or Arab culture.

Proposed schedule

Semester 1

Code	Course	Credits
020PARGS1	Architectural Project	4
020LEBGS1	Building Rules and Regulations	2
020MMDGS1	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 (Summer Training)	2
020WRNGS1	Communication and Work Ready Now	2
	Total	**34**

Semester 2

Code	Course	Credits
020MEFGS2	Fluid Mechanics	6 Cr.
020PGCGS2	General Construction Procedures	4 Cr.
020MESGS2	Soil and Rock Mechanics	6 Cr.
020STAGS2	Statistics	4 Cr.
020RDMGS2	Strength of Materials	6 Cr.
020ACTGS2	Basis of Structural Design - Structural Load Calculations	4 Cr.
	Arabic Open Elective	2 Cr.
	Total	**32**

Semester 3

Code	Course	Credits
020FOSGS3	Foundation Engineering	6
020HYDGS3	Hydraulics	6
020BEAGS3	Reinforced Concrete	6
020CMMGS3	Steel Structures	6
	Options Required Courses (8 Cr)	
	Option Buildings and Engineering Management	
020ACIGS3	American code of reinforced concrete	4
020QUAGS3	Quality Management in Buildings	2
020GEFGS3	Buildings Finance Management	2
	Option Water and Environment	
020DEAGS3	Water Distribution Networks	4
020GISGS3	Geographic Information Systems	2
020DREGS3	Environmental Law	2
	Option Public Works and Transport	
020ACIGS3	American code of reinforced concrete	4
020TRAGS3	Traffic Engineering	2
020AERGS3	Transport and Airport Engineering	2

	Total	**32**

Semester 4

Code	**Course**	**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
	Options Required Courses (6 Cr.)	
	Option Buildings and Engineering Management	
020RESGS4	Building Lighting and Sanitary	4
020CTHGS4	Building Thermal Design	2
	Option Water and Environment	
020IMPGS4	Environmental Impact Assessment	2
020IRRGS4	Irrigation	2
020ASSGS4	Wastewater Distribution Networks	2
	Option Public Works and Transport	
020ROUGS4	Road and Pavement Engineering	4
020PLSGS4	Structures Plastic behavior	2
	Restricted Civil Engineering Elective	2
	Open Elective	2
	Total	**34**

Semester 5

Code	**Course**	**Credits**
020STEGS5	Summer Internship	4
	Option Required Courses (28 Cr.)	
	Option Buildings and Engineering Management	
020ACBGS5	Building Acoustics	2
020SEIGS5	Building Fire Safety	2
020COSGS5	Design of Buildings Structures	4
020MOGGS5	Market Globalization	2
020PLGGS5	Planning and Management of Large-Scale Projects	4
020BPRGS5	Prestressed Concrete in Buildings	2
020REMGS5	Rehabilitation and Maintenance of Concrete Structures	4
020OSPGS5	Special Topics in Concrete	2
020DYSGS5	Structural Dynamics and Earthquake Engineering	4
020LOCGS5	Structural Software	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 Transport	
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	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 Transport Final Year Project FYP	16
	Total	**16**

Course Description

020ACIGS3 American Code of Reinforced Concrete (ACI) 4 Cr.
A course that is based on the design of reinforced concrete structures according to the American Concrete Institute (ACI) code. Topics 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. The student applies theoretical, topographical, hydrological and hydraulic principles in the dimensioning of specific hydraulic structures. Topics include: Basic hydraulic principles - Basic hydrology - Culvert hydraulics – Surface water modeling and flood routing using HEC-RAS.
Prerequisites: None

020ARAGS2 Arabic 2 Cr.
A course in Arabic language
Prerequisites: None

020PARGS1 Architectural Project 4 Cr.
The objective of this course is to teach students how to conceptualize, design and interpret an architectural project. Topics 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)

020ASTGS4 Astronomy 2 Cr.
This course provides students with basic astronomical knowledge that allows them to better understand the importance of current and future space discoveries. Topics 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.
The aim of this course is to make students aware of sound transmission problems in buildings in order to ensure a better life quality by respecting the acoustic comfort requirements. The current European standards will be applied to define the acoustic performance of each building according to its usage and exposure. Topics 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 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.
The objective of this course is to show 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 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.
A course on fire safety in buildings of different types and occupational sizes. Topics 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.
The purpose of this course is to provide students with a theoretical and practical overview of the different systems and sanitary facilities. Topics 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 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.
Course covers all the necessary elements to achieve thermal building design while ensuring the maximum comfort to the user. Topics 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.
Introduce 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.
Study 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 is designed to provide 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 give a general view of the different categories of engineering materials and their behavior and teach the students the properties and the fields of use of materials in civil engineering. Topics 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.
A course that aims to give students the basic tools to describe and model solid and fluid material environments. This course gives the essential background needed in specialized courses such as mechanics of materials, fluid mechanics, reinforced concrete, soil and rock mechanics and rheology of materials. Topics 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.
Learn to become creative in your analysis of specific situations.
Prerequisites: None

020BAGGS5 Dams 4 Cr.
This course provides an analysis of the elements to be considered for selection and sizing of different types of dams and their appurtenant structures and to compare different solutions technically, economically and environmentally. Topics 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 – Mobile dams on water courses.
Prerequisites: None

020MEAGS5 Data Measurement and Acquisition 2 Cr.
This course aims at understanding the operation and use of water-related measurement devices and their environment in associated sensors and electronics. The analysis of the ranges and the conditions of use, as well as the supports necessary for the collection of information. The estimation of the precision of measurements, the processing and the transformation of the data by adequate means to present them in the units relating to the measured quantities. The design of a system and a measurement protocol. The definition of the criteria of choice of measuring equipment. The apparatus studied relates most often to pressurized flows. Topics 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.
The design of structures is an essential phase prior to any calculation; its aim is to teach students the techniques of design and analysis of real structures. Topics 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.
Enhance the skills of Job Seekers by learning how to make a good presentation and write a professional report.
Prerequisites: None

020CDAGS4 Engineering Contracts and Laws of Arbitration 2 Cr.
Learn the Principles of Contracts - Study the Law of Arbitration.
Prerequisites: None

020GEIGS4 Engineering Geology 2 Cr.
This course covers an applied geology discipline that involves the collection, analysis, and interpretation of geological data and information required 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.
Have sufficient language skills in scientific English
Prerequisites: None

020EFEGS4 Entrepreneurship for Engineers 2 Cr.
Explain the Entrepreneurship field for Engineers.
Prerequisites: None

020ENVGS1 Environment and Sustainable Development 2 Cr.
This course provides a comprehensive presentation on Environment and Sustainable Development to enable the student to assess and analyze the major environmental and development problems as well as challenges facing the humanity and to help him/her suggesting some practical and concrete issues. Topics 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.
A course that introduces environmental impact assessment (EIA) of projects as a main tool for the application of the principle of prevention in the protection of the environment. Topics 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 aims to enlighten students on the main environmental, ecological and water scarcity problems as well as the main regulations and laws put in place to face them. Topics 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 of engineers with each other and with the order of engineers. Topics 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 difficulties of the preparation of public events of all kinds. Topics 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.
Allow students to apply their previously acquired knowledge for the study of a real civil engineering work. Complete study of a civil engineering work.
Prerequisites: None

020PEAGS6 Final Year Project 16 Cr.
Allow students to apply their previously acquired knowledge for the study of a real civil engineering work. Complete study of a civil engineering work.
Prerequisites: None

020PTPGS6 Final Year Project 16 Cr.
Allow students to apply their previously acquired knowledge for the study of a real civil engineering work. 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. This course provides the necessary elements for students to develop their own technical skills and interact appropriately with various software. Topics 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.
A course that introduces the students to the basic principles of fluid statics and dynamics. Topics 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 Foundations Engineering 6 Cr.
A course that introduces the student to the calculation methods and rules of the art in the field of design and construction of foundations and retaining structures. 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 thrust and thrust, and apply them to the calculation of retaining walls and different types of walls. Design the piles. Introduction, Geotechnical Design - Reminder Geotechnical Properties - Site Investigation and Exploration - In Situ Testing - Superficial Foundations – Active and Passive Pressures - Retaining Structures - Excavations and Groundwater Control - Deep Foundations.
Prerequisites: Soil and Rock Mechanics (020MESGS2)

020EREGS2 From Engineering to real Estate Development 2 Cr.

Introduction to the Real Estate field. Explain 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, the course will propose 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.
The objective of this course is to familiarize the students with the different accounting documents, to enable them to establish the profit and loss accounts and the balance sheets. Moreover, they will know how to 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, they will have in-depth knowledge of the different external stakeholders in the life of the company. 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 aims to teach engineering students the main problems related to the execution of building construction projects. Topics 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 give students the necessary notions of microeconomics with an emphasis 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: it shows 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.
Teach students 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 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 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 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 – Laboratory Experiments: Hydrological bench – Permeability bench – Coagulation, flocculation and decantation bench.
Prerequisites: Hydraulics (020HYDGS3)

020INDGS4 Industrial Construction 2 Cr.
The course consists of an interactive platform where the participation of the student is continuous. It is rich in examples supported by recent and less recent photos, in short films and presentations to fix the ideas on the theoretical notions already acquired and to open a new dimension to the student engineer on the way of designing and executing a construction. Topics 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. Selected topics: 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 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.
A course about karst nomenclature and definitions, basic concepts for understanding karst development and related groundwater flows. Introduction to methods in karst hydrogeology and geotechnical problems related to karst. Topics include: 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 in negotiation, especially through practical case studies and role plays to allow the students to better understand the subtleties and problems they will face in their professional life. Topics 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 aims to give the students the basic elements in order to assess and analyze the seawater effects on the constituent elements of a port or a maritime structure. Topics 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.
A course about the design of foundations and structural elements of reinforced concrete building. Topics 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 the students with the numerical tools and computational techniques needed to solve the equations and models encountered in the field of Civil Engineering. Topics 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 the 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 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.
A course about the theoretical elements needed to pre-dimension and analyze structural elements such as slabs, walls, roof, tanks and folded structures. Topics 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.
A course about the basic principles of the behavior of prestressed concrete structures with a focus on building applications. Topics 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 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 deals with the protection and aesthetic aspects of constructions, especially paints, sealing problems, etc. Topics 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.
An introductory course on quality in management systems and particularly in the field of construction where risk, safety and economic issues are important. Topics 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 the design of the various types of bridges. The course examines the causes of disorders of existing bridges and the techniques used for their repair and reinforcement. Topics 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 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 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 aims at learning how to draw a road and design its roadways. Topics 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.
This course aims to 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. Recall of stress theory and failure criteria - Evaluation of shear strength - Shear strength of powdery soils - Shear strength of cohesive soils - Resistance to cyclic shear - Effect of earthquakes - Importance of landslide problems - Slope stability: Stability calculation and reinforcement methods - General introduction to geo-environment - Basics of understanding soil behavior in environmental geotechnics - Contaminants and contamination in

environmental geotechnics - Transport of contaminants in soils - The recognition and investigation of polluted sites - Design of landfills - Restoration of contaminated sites.
Prerequisites: Foundation Engineering (020FOSGS3)

020MESGS2 Soil and Rock Mechanics 6 Cr.
This course provides the essential basis for understanding 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 interstitial 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. General and Geological Recall - Soil Classification Properties and Indexes - Soil Classification - Clay Minerals and Soil Structure - Compaction and Road Geotechnics - Capillarity, Removal, Swelling, Frost Action - Water in Soils: Permeability and Networks flow - Consolidation and settlement - Consolidation velocity - Mohr-Coulomb criterion and Shear resistance - Geo-environmental concepts.
Prerequisites: Geology (020GELNI4 or 020GELCI4)

020DESGS5 Solid Waste Management 2 Cr.
A course dealing with municipal solid waste problems and treatment methods. Topics 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 deals with 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 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.
The objective of the course is to give students a notion of basic statistics. Topics 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 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.
A course about understanding the behavioral law of the materials. Calculate and analyze the characteristics of the cross sections, as well as the distribution of 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.
Give the necessary elements to understand the dynamics of the structures and size the structures to withstand earthquakes according to the PS92 regulation. Topics 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.
A course about structural forms; influence lines; effects of temperature loads on structures, analysis of arches, trusses, continuous beams, 2D frames, grids and 3D frames. Topics 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.
To give students the basic elements of plasticity, currently used in the new calculation codes in civil engineering. Content: 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 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. Content: 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.
Allow students to undertake their first work experience in a professional environment, namely design offices and construction sites. This internship lasts 8 weeks. Internship in a design office or on site.
Prerequisites: None

020STOGS1 Surveying 2 Cr.
Use of topographic material for field surveys. Use of topographic equipment: tachometer, theodolite, level, prism square, workstation.
Prerequisites: Topography (020TOGNI4)

020TRAGS3 Traffic Engineering 2 Cr.
This course allows students to study and analyze the road traffic of a region. The different elements and functions of a road or highway. Topics 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 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.
Teach urban planning rules to students.
Prerequisites: None

020GEPGS5 Water and Wastewater Treatment 4 Cr.
A course that examines the methods of water and wastewater treatment. Topics 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

020ASSGS4 Wastewater Distribution Networks 2 Cr.
A course on the design of urban sanitation networks. Topics 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)

020DEAGS3 Water Distribution Networks 4 Cr.
This course introduces the water management process, that is, the relationship between natural water and water treatment. It contains essential information for modeling, dimensioning, scenario simulation and the choice of equipment needed to provide citizens with sufficient water and adequate pressure. Topics 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

Department of Electrical and Mechanical Engineering

Computer and Communications Engineering

Main Language of Instruction:

French: ◙	English: ◙	Arabic: □

Campus where the Program is Offered: CST

Objectives

The Computer and Communications Engineering program 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (150 credits), Institution's elective courses (26 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits – part of the above categories)

USJ General Education Program (26 Cr.)
At least 10 additional credits are earned at the Department of Preparatory Classes

- English (4 Cr.)
  - English Level A (4 Cr.)
- Arabic (4 Cr.)
  - Arabic Culture and Language (2 Cr.)
  - Business Law (2 Cr.)
- Humanities (4 Cr.)
  - Business Ethics (4 Cr.)
- Social Sciences (6 Cr.)
  - Project Management (4 Cr.)
  - One Institution's elective course (2 Cr.) to be selected between:
    - Work Ready Now (2 Cr.)
    - Entrepreneurship (2 Cr.)
- Communication Techniques (8 Cr.)

Communication Skills (2 Cr.)
Multidisciplinary Project (2 out of the 6 credits of the course)
Final Year Project (4 out of the 16 credits of the course)

Fundamental Courses

Required Courses (150 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.)
- English Level A (4 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 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 his 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 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 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.)

Advanced Microcontroller Systems (4 Cr.)
Advanced Networking and WAN technologies (4 Cr.)
Architectures of Information Technologies for Enterprises (4 Cr.)
Cloud and Digital Transformation (4 Cr.)
Computer Vision (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.)
Internet Ecosystem and Evolution (4 Cr.)
Internet of Things Technologies (4 Cr.)
Introduction to Data Science (4 Cr.)
Machine Learning (4 Cr.)
Microwave Links and Circuits (4 Cr.)
Mining Massive Datasets (4 Cr.)
Mixed-Signal IC Design (4 Cr.)
Mobile Applications Development (4 Cr.)
NoSQL Databases (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.)

Open Elective Courses (4 Cr.)

Arabic Culture and Language (2 Cr.)
One Open elective course (2 Cr.)

Suggested Study Plan

Semester 1

Code	Course Name	Credits

020ELAES1	Analog Electronics	6
020INRES1	Introduction to Data Networks	6
020CPPES1	Object-Oriented Programming	6
020GPRES2	Project Management	4
020THSES2	Signal Theory	4
020STAES1	Statistics	4
	Institution's Elective course	2
	Total	**32**

Semester 2

Code	**Course Name**	**Credits**
020CONES3	Analog and Digital Communications	6
020TCOES2	Communication Skills	2
020ELNES2	Digital Electronics	6
020TROES2	Graph Theory and Operational Research	4
020RCOES2	Network Routing and Switching	4
020BDRES2	Relational Databases	4
020ADUES3	Unix System Administration	4
	Open Elective: Arabic Language and Culture	2
	Total	**32**

Semester 3

Code	**Course Name**	**Credits**
020ETHES3	Business Ethics	4
020SDAES3	Data Structures and Algorithms	4
020INDES2	Innovation and Design Thinking	2
	For the Software Engineering Option (16 Cr.)	
020ADPES3	Analysis and Design of Information Systems	4
020IA2ES4	Artificial Intelligence	4
020AROES3	Computer Architecture	4
020MCOES3	Design Patterns	4
	For the Telecommunication Networks Option (16 Cr.)	
020TNSES3	Digital Signal Processing	4
020SMPES3	Microprocessor Systems	4
020PGAES3	Waveguides and Antennas	4
020CSFES3	Wireless Communications	4
	Institution's Elective course	8
	Total	**34**

Semester 4

Code	**Course Name**	**Credits**
020ANGES4	English	4
020PRMES4	Multidisciplinary Project	6
	For the Software Engineering Option (12 Cr.)	
020PCOES4	Compiler Principles	4
020APDES4	Distributed Applications	4
020SSEES4	Operating Systems	4
	For the Telecommunication Networks Option (12 Cr.)	
020REMES4	Mobile Networks	4
020SYOES4	Optical Systems and Networks	4
020PSRES4	Performance of Computer Systems and Networks	4

	Open Elective	2
	Institution's Elective course	8
	Total	**32**

Semester 5

Code	Course Name	Credits
020CMPES5	Accounting	4
020DROES5	Business Law	2
020STGES5	Corporate Internship	2
020MNGES5	Management	2
	For the Software Engineering Option (16 Cr.)	
020VIRES5	Computer Virology	4
020IAEES5	Enterprise Application Integration	4
020PPLES5	Parallel Programming	4
020GLOES5	Software Engineering	4
	For the Telecommunication Networks Option (16 Cr.)	
020TICES5	Information Theory and Coding	4
020IDRES5	Network Engineering	4
020QOSES5	Quality of Service in Networks	4
020RESES5	Secured Enterprise Networks	4
	Institution's Elective course	8
	Total	**34**

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, Current Liabilities. Concepts of Cost Accounting, Advantages of Cost Accounting, Classification and Elements of Cost, 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)

020RLIES4 Advanced Networking and WAN Technologies **4 Cr.**

This course covers the third and fourth semester 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)

020CONES3 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)

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 (020SRLCI4 or 020SRLNI4)

020ADPES3 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.

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 target of this course if 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.

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.

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. 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.

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.

020CLDES5 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 Communications 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 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 Computer Architecture 4 Cr.

Computer evolution and performance - Von Neumann model – interconnection structures – memory systems - inputs/outputs - instruction sets – processor structure and function - pipelines - RISC and CISC – ILP and superscalar processors - parallel architectures and organizations.

Prerequisite: Digital Systems Design (020TEDCI4 or 020TEDNI4)

020VIRES5 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.

020TIMES4 Computer Vision 4 Cr.

Introduction to digital images (acquisition and visualization, sampling, fundamental principles of digital images) - Basic image processing (Concept of histogram and its uses, morphological operations, etc.) - Digital filtering of images and detection of points of interest and contours (median filter, bilateral filter, etc., Sobel detector, Canny detector, FAST, SIFT, etc.) - Image segmentation using traditional techniques (thresholding methods, image region division, etc.) - Image denoising and restoration: methods based on statistical principles, deterministic methods, and machine learning - Image processing/computer vision with convolutional neural networks (image classification, object detection and localization, facial recognition, image segmentation, etc.).

Prerequisite: Signal Theory (020THSES2)

020IDCES5 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. This course is an elective for 4th and 5th year CCE students and requires no prerequisites. Upon completion, students will be well-prepared for careers in software development and IT operations.

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 formation - experiment situations of human relationships that occur in the different environments where engineers may work - acquire experience and knowledge that facilitate future professional integration.

020CRYES4 Cryptography 4 Cr.

Introduction on threats and attacks – services: authentication, integrity, confidentiality, non-repudiation – security mechanisms and technics: algorithms, smart cards, key management, certificates… – 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 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…), , scheduling problems, flow problems (maximum flow, minimum cost flow problem,…), coupling, dynamic programming.

020MCOES3 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 the students to the use of documentation, and application monitoring (profiling, logs, and traces) tools.

020ELNES2 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 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)

020TNSES3 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)

020APDES4 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)

020SEMES3 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.
Prerequisites: Digital Systems Design (020TEDCI4 or 020TEDNI4) and Programming 1 (020IF1CI2 or 020IF1NI2)

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.

020IAEES5 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.

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 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 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.
Prerequisite: Having validated 150 credits

020PFSES3 Functional Programming 4 Cr.
The goal 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 mutli-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 of 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)

020TROES2 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 networks 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. This course will discuss the ISO 27001-2 2022 standard, PCI DSS 4.0, OWASP, SANS-CIS V8 top 18 cyber security controls. This course 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.

020TICES5 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 covers also the channel coding technics 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)

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 will be 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 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)

020IDOES5 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)

020INRES1 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 teaching unit offers a set of practical exercises that introduces the student 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 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.

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 (020TEDCI4 or 020TEDNI4)

020PCHES3 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 (020EMECI3 or 020EMENI3)

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 Mixed-Signal IC Design 4 Cr.

In this applied course, the 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)

020DMOES4 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 will 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 will 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 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)

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.

020IDRES5 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 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)

020BDAES6 NoSQL Databases 4 Cr.

This course on advanced databases 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)

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: (Differential Calculus (020CDFNI4) or Analysis 2 (020AN2CI3)) and (Linear Algebra (020LALNI2) or Algebra 1 (020AL1CI2))

020CPPES1 Object-Oriented Programming 6 Cr.

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)

020SSEES4 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 -
Process synchronization - Deadlocks in multi-processing - Memory management - Virtual memory management - CPU scheduling algorithms - File system - Disk subsystem - Security.

020ROPES5 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)

020SYOES4 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 (020EMECI3 or 020EMENI3)

020PPLES5 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)

020PSRES4 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: Algebra 3 (020AL3CI4) or Probability (020PRBNI3)

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 will also cover 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)

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.

020QOSES5 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)

020BDRES2 Relational Databases 4 Cr.
Introduction to databases - Relational model - Relational algebra - Functional dependencies - Normal forms - Relational database construction theory - Data dictionary, SQL (DDL, DML), Views, Triggers, PL / SQL, Stored Procedures and Functions - transactions and concurrency - optimistic locking and two-phase commit - introduction to non-relational databases.

020RESES5 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)

020THSES2 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.
Prerequisites: (Analysis 2 (020AN2NI4) or Analysis 3 (020AN3CI4)) and (Algebra 3 (020AL3CI4) or Probability (020PRBNI3))

020GLOES5 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, as well as it describes many specification tools used for functional and non-functional requirements analysis. 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 chirurgical, 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.

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'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.
Sampling distribution - Estimation by confidence intervals, estimation by maximum likelihood, and estimation by the method of moments - Hypothesis tests for the mean, the variance, the proportion, independence and fitting to a distribution - Simple and multiple linear regression - Non-parametric tests.
Prerequisite: Algebra 3 (020AL3CI4) or Probability (020PRBNI3)

020ADUES3 Unix System Administration 4 Cr.
Unix fundamentals - Shell and basic commands - File system - User management - Text editors - Shell scripting - Processes - Permissions - System configuration - Periodic tasks - Network configuration - System security.

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 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 (020EMECI3 or 020EMENI3)

020PWBES3 Web Programming 4 Cr.

This course covers the development of web applications on both the front-end (client-side) and the back-end (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 front-end has been fully implemented while the back-end 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 front-end, 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 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. The course 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 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.

Electrical Engineering

Main Language of Instruction:

French: ◙	English □	Arabic: □

Campus where the Program is Offered: CST

Objectives

The Electrical Engineering program 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (154 credits), Institution's elective courses (22 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits - part of the above categories)

USJ General Education Program (26 Cr.)
At least 10 additional credits are earned at the Department of Preparatory Classes
- English (4 Cr.)
  - English Level A (4 Cr.)
- Arabic (4 Cr.)
  - Arabic Culture and Language (2 Cr.)
  - Business Law (2 Cr.)
- Humanities (4 Cr.)
  - Business Ethics (4 Cr.)
- Social Sciences (6 Cr.)
  - Project Management (4 Cr.)
  - One Institution's elective course (2 Cr.) to be selected between:
    - Work Ready Now (2 Cr.)
    - Entrepreneurship (2 Cr.)
- Communication Techniques (8 Cr.)
  - Communication Skills (2 Cr.)
  - Multidisciplinary Project (2 out of the 6 credits of the course)
  - Final Year Project (4 out of the 16 credits of the course)

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 Level A (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 his 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 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 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.)
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.)

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	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 Level A	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)

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.

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. 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 ways of communication (written, verbal and non-verbal) and making 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 formation - experiment 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 offers a comprehensive understanding of mechatronics and microcontroller systems, emphasizing the integration of mechanical components, electronics, and data-driven control. Students will explore topics such as numbering systems, microcontroller architecture, assembly language programming, A/D and D/A conversion, parallel I/O, programmable timer operation, and the interfacing of sensors and actuators. Through theoretical knowledge, students will develop the skills required

to design and implement mechatronic systems for various applications. Furthermore, they will collaboratively engage in a team project focused on applying these skills to real-world scenarios.
Prerequisite: Sensors and Instrumentation (020CEIES3).

020ELNES2 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 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 discuses discrete system modeling, Z-transform, discrete transfer function and discrete systems stability. The second part develops the design of digital controllers (discretized classic controllers, dead-beat control). The final part presents the implantation of digital controllers using embedded system 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.

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.

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.

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.

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: Having validated 150 credits

020MEFES2 Fluid Mechanics 4 Cr.

Provides the fundamental elements for understanding incompressible fluid flow. Topics include 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 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.

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).

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 6 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.

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.

The aim of this course is to learn about the creative mindset and particular practices that enable innovation. Throughout this course, students will be 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.

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.

In this applied course, the 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)

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)] and [Differential Calculus (020CDFNI4) or Analysis 2 (020AN2CI3)].

020CPPES1 Object-Oriented Programming 6 Cr.

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 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 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 6 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 will also cover 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)

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 will cover the operating conditions of steam and gas cycles at design conditions and partial loads. Economic and environmental aspects are discussed.

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.

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 (covering the solar spectrum, impact of geometry, and atmospheric attenuation), Solar Thermal and Solar Electric Photovoltaics (PV) with a focus on applications, PV System Components, Design, Selection & Sizing, as well as the Basics of Solar Energy System Engineering Economics. The curriculum also explores the origin and power of wind, historical perspectives on wind turbines, Wind Energy System Components, Turbine Design & Control, Electrical Aspects of Wind Turbines, and the essentials of Wind Energy System Selection & Sizing, along with Wind Energy System Engineering Economics Basics. This comprehensive examination equips participants with the knowledge and skills needed to navigate the complex landscape of renewable energies.

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 also be 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.) will also be 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 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.
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.
Sampling distribution - Estimation by confidence intervals, estimation by maximum likelihood, and estimation by the method of moments - Hypothesis tests for the mean, the variance, the proportion, independence and fitting to a distribution - Simple and multiple linear regression - Non-parametric tests.
Prerequisite: Probability (020PRBNI4) or Algebra 3 (020AL3CI4).

020IPRES5 System identification 4 Cr.
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. 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. 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.

Mechanical Engineering

Main Language of Instruction:

French: ◙	English □	Arabic: □

Campus where the Program is Offered: CST

Objectives

The Mechanical Engineering program 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

- 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 specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- An ability to communicate effectively 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 function effectively 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 (150 credits), Institution's elective courses (26 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits - part of the above categories)

USJ General Education Program (26 Cr.)
At least 10 additional credits are earned at the Department of Preparatory Classes

- English (4 Cr.)
  - English Level A (4 Cr.)
- Arabic (4 Cr.)
  - Arabic Culture and Language (2 Cr.)
  - Business Law (2 Cr.)
- Humanities (4 Cr.)
  - Business Ethics (4 Cr.)
- Social Sciences (6 Cr.)
  - Project Management (4 Cr.)
  - One Institution's elective course (2 Cr.) to be selected between:
    - Work Ready Now (2 Cr.)
    - Entrepreneurship (2 Cr.)
- Communication Techniques (8 Cr.)
  - Communication Skills (2 Cr.)
  - Multidisciplinary Project (2 out of the 6 credits of the course)
  - Final Year Project (4 out of the 16 credits of the course)

Fundamental Courses

Required Courses (150 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 (4Cr.)
Management (4 Cr.)
Mechanical Systems (6 Cr.)
Mechanical Vibrations (4 Cr.)
Numerical Methods (4 Cr.)
Plumbing (4 Cr.)
Project Management (4 Cr.)
Renewable Energy (6 Cr.)
Sensors and Instrumentation (4 Cr.)
Statistics (4 Cr.)
Strength of Materials (6 Cr.)
Thermodynamics: Principles and Applications (6 Cr.)

Corporate Internships (2 Cr.)
During his 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 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 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.)

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

Energy Track:

Aerodynamics (4 Cr.)
Automotive Propulsion Systems (4 Cr.)
Energy Optimization (4 Cr.)
HVAC 2 (4 Cr.)
Numerical Fluid Mechanics CFD (4 Cr.)
Pollution, Environment and Sustainability (4 Cr.)
Power Generation (4 Cr.)
Profitability of Energy Projects (4 Cr.)

Refrigeration Systems (4 Cr.)
Thermal Engines (4 Cr.)
Turbomachines (4 Cr.)

Mechanical Design Track:
Acoustics and Vibrations (4 Cr.)
Advanced Materials Science (4 Cr.)
Advanced Strength of Materials (4 Cr.)
Biomechanics (4 Cr.)
Design of Mechanisms (4 Cr.)
Fluid Power Systems (4 Cr.)
Machine Design 2 (4 Cr.)
Manufacturing Processes 1 (4 Cr.)
Manufacturing Processes 2 (4 Cr.)
Mechanics of Composite Materials (4 Cr.)
Selection and Properties of Materials (4 Cr.)

Mechatronics Track:
Artificial Intelligence (4 Cr.)
Design of Mechatronic Systems (4 Cr.)
Dynamic Systems Modeling (4 Cr.)
Home Automation (4 Cr.)
Hydraulic Servo Systems (4 Cr.)
Machine Learning (4 Cr.)
Mechatronics and Intelligent Machines (4 Cr.)
Micro-Electro-Mechanical Systems (4 Cr.)
Modern Control (4 Cr.)
Robotics (4 Cr.)
Wheeled Robots (4 Cr.)

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

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	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
020ETHES3	Business Ethics	4
020CAOES2	Computer Aided Drawing and Design	4
020HYDES3	Hydraulics	4
020AULES2	Linear Control	6
020CM1ES3	Machine Design 1	4
020CEIES3	Sensors and Instrumentation	4
	Institution’s Elective course	4
	Total	**34**

Semester 4

Code	**Course Name**	**Credits**
020DROES5	Business Law	2
020ANGES4	English	4
020INDES2	Innovation and Design Thinking	2
020PRMES4	Multidisciplinary Project	6
020GPRES2	Project Management	4
020PLBES4	Plumbing	4
	Institution’s Elective course	8
	Open Elective	2
	Total	**32**

Semester 5

Code	**Course Name**	**Credits**
020CMPES5	Accounting	4
020STGES5	Corporate Internship	2
020ELFES4	Finite Elements for Mechanical Applications	4
020MNGES4	Management	4
020ERNES5	Renewable Energy	6
	Institution’s Elective course	12
	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 or 020ISMCI2).

020RMAES4 Advanced Strength of Materials 4 Cr.

This course concerns the study of stresses due to combined loadings, deflection of beams, principal stresses, absolute maximum shear stress, experimental determination of deformation, buckling of columns, and static failure theories. It brings students to deal with statically indeterminate problems, which are the most present in reality and impossible to solve using only statics. It develops different resolution methods (by integration, superposition, Clapeyron) to determine the reactions at the supports of statically indeterminate members under tension, torsion, bending, and buckling. It also deals with the virtual work theorem, energy methods, static failure theories, three-dimensional state of stress and Mohr's circle in addition to stresses in thin-walled pressure vessels, composite and curved beams, shear centers, and asymmetric bending. It deals also with the plastic analysis of bars, beams, and shafts with elastic perfectly plastic material and two-dimensional problems in elasticity.
Prerequisite: Strength of Materials (020RDMES1) or Strength of Materials 1 (020RM1ES2).

020ARDES3 Aerodynamics 4 Cr.

A course on 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).

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. The course first covers greedy and A* search as well as the implementation of games through the minimax and expectimax algorithms. Then, it introduces some basic supervised Machine Learning algorithms 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 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.
Prerequisite: Mechanical Systems (020SMEES1).

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 deals with the biomechanical principles underlying the kinetics and kinematics of normal and abnormal human motion with emphasis on the interaction between biomechanical and physiological factors (bones, joints, connective tissues, and muscle physiology and structure) in skeleto-motor function and their applications in testing and in rehabilitation practice. It includes introduction to constitutive equations and stress-strain relationships for biomaterials, rheological properties of blood, and biomechanics of vessels and heart.

Prerequisites: Introduction to Materials Science (020ISMNI2 or 020ISMCI2), 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.

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. 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 ways of communication (written, verbal and non-verbal) and making them aware of the errors to be avoided.

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

This course seeks to expose students to computer aided drawing and design (CADD), they will be taught how to 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 will also help 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 formation - experiment 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).

020CSMES4 Design of Mechatronic Systems 4 Cr.

This course offers a comprehensive understanding of mechatronics and microcontroller systems, emphasizing the integration of mechanical components, electronics, and data-driven control. Students will explore topics such as numbering systems, microcontroller architecture, assembly language programming, A/D and D/A conversion, parallel I/O, programmable timer operation, and the interfacing of sensors and actuators. Through theoretical knowledge, students will develop the skills required to design and implement mechatronic systems for various applications. Furthermore, they will collaboratively engage in a team project focused on applying these skills to real-world scenarios.
Prerequisite: Sensors and Instrumentation (020CEIES3).

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 will examine 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 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: Having validated 150 credits

020ELFES4 Finite Elements for Mechanical Applications 4 Cr.

The finite element method is a numerical simulation method widely used by engineers and researchers in all technical and scientific fields. The objective of this course is to show the theoretical basis and the numerical implementation of the finite element method on problems from mechanics of materials and heat transfer. Students are brought to deal with the resolution of second order differential equations in one and two dimensions and with one and two variables. The stiffness method and/or weak formulations are used to obtain the finite element model. The applications deal with problems of bars, trusses, beams, heat

exchangers, frames, plane stresses and plane strains in elasticity. In addition, symmetric and asymmetric problems are also discussed. This course also allows students to communicate effectively with finite element calculation software (Abaqus) and know how to validate and interpret the 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 seeks to cover 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 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) and Linear Control (020AULES2).

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 will be 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.

020IMEES1 Introduction to Electric Machines 4 Cr.

This course introduces to 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.
Corequisites: 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. The students 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. The students continue to learn and size mechanical components in machines such as helical, bevel, and worm gears, brakes, clutches, flywheels, and flexible mechanical elements. They will also study the design of tension, compression, and torsion springs, screws and fasteners, and weld design. Introduction to planetary gear trains and differential transmissions is included. Mechanical organs or elements are studied regarding static, dynamic loads and vibration phenomena.
Prerequisites: Machine Design 1 (020CM1ES3) and 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.

020MNGES4 Management 4 Cr.

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

020PF1ES3 Manufacturing Processes 1 4 Cr.

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

020PF2ES4 Manufacturing Processes 2 4 Cr.

This course covers the main manufacturing processes used in the industry for different types of materials (metal, glass, plastics, rubber, composites, ceramics). It explains the techniques applied during the preparation of a product, from the fabrication of the primary parts to the finishing of the final assembled product. In addition to the "material removal processes" explained in the "Manufacturing Processes 1" course, the covered topics include: solidification processes (casting, molding …), particulate processing, deformation of metals and plastics, and assembly operations (welding, over molding, threading...) Also, the course describes some advanced processes and technologies such as waterjet cutting, laser cutting, layer-design, 3D printing and nanotechnologies.
Prerequisite: Manufacturing Processes 1 (020PF2ES4).

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 deals with the vibrations of one-dimensional systems (1 Degree of Freedom), undamped free oscillations, undamped forced oscillations, free damped oscillations, forced damped oscillations, stability, resonance, and systems with multiple degrees of freedom including mechanical engineering applications and examples. It allows students to learn how to model a system and carry out the analysis of its vibrational behavior. Linear systems with several degrees of freedom are solved with the mode superposition method and with the modal analysis method. An introduction to non-linear systems, resolution by the iterative method, and vibration suppression is also presented.
Prerequisite: Mechanics 2 (020MC2CI3 or 020MC2NI3).

020MMCES4 Mechanics of Composite Materials 4 Cr.

This course focuses on anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, failure theories, and micromechanics. Materials and fabrication processes are introduced.
Prerequisites: Introduction to Materials Science (020ISMNI2 or 020ISMCI2) and 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 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: Sensors and instrumentation (020CEIES3).

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)] and [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.
An overview of the causes and effects of global climate change covering the basic science, projected impacts, and approaches to mitigation. It also includes the methods available to quantify greenhouse gases emissions, control these emissions and adapt to it, especially in the sector of buildings' HVAC/heating systems and building materials. Introduction to natural and anthropogenic carbon cycle, and carbon and climate. Topics also touch on the basic concepts of green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy

efficiency of buildings. Moreover, the course will include the quantification of Air/Water/Soil pollution and their sources, sustainable wastewater treatment, Solid waste (sources and impacts of solid waste), zero waste concept and the 3 R 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 will cover the operating conditions of steam and gas cycles at design conditions and partial loads. Economic and environmental aspects are discussed.
Prerequisite: Fluid Mechanics (020MEFES1) or Fluid Mechanics 1 (020MF1ES1).

020RPEES5 Profitability of Energy Projects 4 Cr.

The aim of this course is to allow students to understand, using economic tools, the profitability of an energy project: 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).

020ERNES5 Renewable Energy 6 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 potential 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, geothermal energy level, type of systems; Energy storage, electrical batteries, fuel cells, pumped storage system. Also, Socio-economic analysis and lifecycle analysis of renewable energy systems are 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 also be 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.) will also be emphasized in this course.

020SPMES4 Selection and Properties of Materials 4 Cr.

This course deals with 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. Then, it introduces the strategy of selection following manual and computer-aided methods. It studies the selection procedure for applications having multiple constraints and conflicting objectives and treats several examples of simple and multiple selection problems. It also 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.
Sampling distribution - Estimation by confidence intervals, estimation by maximum likelihood, and estimation by the method of moments - Hypothesis tests for the mean, the variance, the proportion, independence and fitting to a distribution - Simple and multiple linear regression - non-parametric tests.
Prerequisite: Probability (020PRBNI4) or Algebra 3 (020AL3CI4).

020RDMES1 Strength of Materials 6 Cr.
This course develops the phenomena dealing with a deformable solid subjected to a system of external loads: fundamental hypotheses of the theory of beams and elasticity, geometric characteristics of sections, types of stresses, generalized Hooke's law, axial stresses (mechanical stresses, thermal stresses, and deformations), bending of beams and transverse shear (normal stresses, shear stresses, and displacements), torsion of cylindrical members (stresses, deformations), 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 pressure vessels. It also deals with the calculation of principal stresses, maximum in-plane shear stress and absolute maximum shear stress. In addition, this course leads students to understand the different static failure criteria for ductile and brittle materials. Students will be brought to deal with tensile test on a steel reinforcing construction bar, compressive test on a cylindrical concrete specimen, and twist tests on steel, brass, and copper specimens.
Prerequisite: Statics for Mechanical Engineering (020STMNI4 or 020STMCI4).

020MOTES4 Thermal Engines 4 Cr.
A course that 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 and 4-stroke engines, supercharges and performance characteristics; thermochemistry of air-fuel mixtures; social implications of motorization.
Prerequisites: General Chemistry (020CHGNI1 or 020CHGCI1) and 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 aims to make students aware of 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.

020CM2ES4 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.