BACHELOR OF ENGINEERING IN INDUSTRIAL ENGINEERING

Main Language of Instruction:
French ☑   English ○   Arabic ○

Campus Where the Program Is Offered: CST

OBJECTIVES

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

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

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

PROGRAM REQUIREMENTS

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

USJ General Education Program (26 Cr.)
10 additional credits are earned at the Department of Preparatory Classes
English (4 Cr.)
  English Level A (4 Cr.)
Arabic (4 Cr.)
  One Arabic Culture and Language course (2 Cr.) to be selected between:
    Arabic Language and Media (2 Cr.)
    Arabic Language and Arts (2 Cr.)
    Arabic Language: Contemporary Novel, Cinema, and Theater (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.) Business Ethics (4 Cr.) Business Law (2 Cr.) Communication Skills (2 Cr.) Control Systems (6 Cr.) Design and Analysis of Experiments (6 Cr.) Digital Factory 1 (6 Cr.) Electrical Systems (6 Cr.) Electronics (6 Cr.) Engineering Economics (6 Cr.) English Level A (4 Cr.) Facilities Planning and Design (6 Cr.) Human Factor and Ergonomics (6 Cr.) Industrial IoT (4 Cr.) Innovation and Design Thinking (2 Cr.) Inventory Control (4 Cr.) Management (4 Cr.) Manufacturing Processes 1 (4 Cr.) Mechanical Structures (6 Cr.) Operations Research and Optimization (6 Cr.) Production Control (6 Cr.) Project Management (4 Cr.) Quality Control & Reliability (6 Cr.) Statistics (4 Cr.) Systems Simulation (6 Cr.) Work Methods and Analysis (6 Cr.)

Corporate Internships (2 Cr.) – During their studies, each student can complete two internships:
- A recommended labor internship of at least 4 weeks at the end of the third year of studies.
- A required technical internship of 6 to 10 weeks at the end of the fourth year of studies (2 Cr.).

Multidisciplinary Project (6 Cr.)
This project brings together students from different programs and/or options where each student participates in the execution of a task related to their field. It aims to provide hands-on design experience, strengthen their analysis capacity, and develop their communication skills and teamwork ability. In this project, students must apply the knowledge acquired throughout their academic years of study and provide a final product that went through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

Final Year Project (16 Cr.)
The final year project is carried out by groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval of a faculty member. Students must define the project, specify its objectives, perform a state of the art of the studies topic, establish the project specifications and select a design method. In this project, students must apply the knowledge acquired throughout their academic years of study and provide a final product that went through all stages of design, modeling, analysis, testing and evaluation. A final report and two oral presentations are the main deliverables of the project.

Institution's Elective Courses (26 Cr.)
Automobile (4 Cr.). Relational Databases (4 Cr.). Sensors and Instrumentation (4 Cr.). Production Chain and Logistics (4 Cr.). Cloud and Digital Transformation (4 Cr.). Computer Aided Drawing and Design (CADD) (4 Cr.). Design of Mechanisms (4 Cr.). Design of Mechatronic Systems (4 Cr.). Renewable Energy (4 Cr.). Entrepreneurship (2 Cr.). Manufacturing systems (4 Cr.). Mechatronics and Intelligent Machines (4 Cr.). Industrial process and control (4 Cr.). Manufacturing Processes 2 (4 Cr.). C++ programming (4 Cr.). Robotics (4 Cr.). Space and micro/nano satellite technologies (4 Cr.). Embedded Systems (4 Cr.). Digital Factory 2 (4 Cr.). Work ready now (2 Cr.).

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

SUGGESTED STUDY PLAN

Semester 1

Code	Course Name	Credits
020TCOES2	Communication Skills	2
020ELCES1	Electronics	6
020FHEES1	Human Factor and Ergonomics	6
020STMES1	Mechanical Structures	6
020STAES1	Statistics	4
020MEAES1	Work Methods and Analysis	6
	Institution's Elective course: Work Ready Now or Entrepreneurship	2
	Total	**32**

Semester 2

Code	Course Name	Credits
020SELES2	Electrical Systems	6
020ENEES2	Engineering Economics	6
020IITES2	Industrial IoT	4
020INDES2	Innovation and Design Thinking	2
020PF1ES2	Manufacturing Processes 1	4
020GPRES2	Project Management	4
020GEQES2	Quality Control & Reliability	6
	Open Elective: Arabic Language and Culture	2
	Total	**34**

Semester 3

Code	Course Name	Credits
020ASCES3	Control Systems	6
020UN1ES3	Digital Factory 1	6
020PCIES3	Facilities Planning and Design	6
020GEPES3	Production Control	6
	Institution's Elective course	8
	Total	**32**

Semester 4

Code	Course Name	Credits
020ETHES3	Business Ethics	4
020ANGES4	English	4
020GSTES4	Inventory Control	4
020PRMES4	Multidisciplinary Project	6
020ROOES4	Operations Research and Optimization	6
	Institution's Elective course	8
	Open Elective	2
	Total	**34**

Semester 5

Code	Course Name	Credits
020CMPES5	Accounting	4
020DROES5	Business Law	2
020STGES5	Corporate Internship	2
020PEXES5	Design and analysis of Experiments	6
020MNGES4	Management	4
020SSYES5	Systems Simulation	6
	Institution's Elective course	8
	Total	**32**

Semester 6

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

COURSE DESCRIPTION

020CMPES5   Accounting   4 Cr.

Topics covered include: Definition of Accounting, Accounting Process, Accounting Concepts, Classification of Accounts, Rules of Double Entry Accounting System, Rules of Journal, Current Assets, and Current Liabilities. Concepts of Cost Accounting, Advantages of Cost Accounting, Classification and Elements of Cost, and Preparation of Cost Sheet.

020AUTES3   Automobile   4 Cr.

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

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.

020CLDES5   Cloud and Digital Transformation   4 Cr.

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

and for business efficacy and innovation. Who are the players and what are their offers? How are multinational firms taking advantage of the Cloud for their businesses? Hands-on labs and a study of a Smart Home use case using Cloud.

020TCOES2	Communication Skills	2 Cr.

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

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

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

020ASCES3	Control Systems	6 Cr.

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

020STGES5	Corporate Internship	2 Cr.

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

020PCPES2	C++ Programming	4 Cr.

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

020PEXES5	Design and Analysis of Experiments	6 Cr.

This course teaches the application of statistics to reach an optimal process performance, using ANOVA and factorial design. It covers the study of levels and factors leading to better system outcome. This course also

provides knowledge and skills in industrial software systems management, i.e., the planning, procurement, development and integration of software systems in an industrial engineering context. It introduces students to data manipulation using Spreadsheet like Excel and data investigation like Access. The course also considers the underlying industrial processes. It prepares students for both technology-intensive professions, e.g. system development (ERD software drawing will be used like Visio), and project management software like MS Project, within organizations supplying or acquiring industrial information and control systems.
Prerequisite: Statistics (020STAES1).

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 Structures (020STMES1).

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).

020UN1ES3	Digital Factory 1	6 Cr.

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

020UN2ES4	Digital Factory 2	4 Cr.

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

020SELES2	Electrical Systems	6 Cr.

Topics covered include: Magnetic materials and circuits - Three-phase 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.
This course also introduces students to the expanding field of power electronics in the domain of industrial applications. It is articulated around the following main topics: first, the characteristics of power semiconductor devices (ideal vs practical), which are used as switches to perform the power conversions from ac-dc, dc-dc, dc-ac and ac-ac, then an in-depth study of the operation, analysis, and design of single-phase and three-phase thyristor-based power rectifiers.
Prerequisites: Electromagnetism (020EMENI3 or 020EMECI3), Linear Electrical Systems and Networks (020SRLNI4 or 020SRLCI4).

020ELCES1	Electronics	6 Cr.

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

020SEMES3	Embedded Systems	4 Cr.

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

020ENEES2	Engineering Economics	6 Cr.

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

020ANGES4	English	4 Cr.

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

020ENTES1	Entrepreneurship	2 Cr.

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

020PCIES3	Facilities Planning and Design	6 Cr.

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

020PFEES6	Final Year Project	16 Cr.

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

020FHEES1	Human Factor and Ergonomics	6 Cr.

This is an introductory course to the field of human factors engineering. Human factors experts draw from research in engineering, psychology, cognitive science, and organization science to solve problems and to invent designs to prevent or mitigate the harm from errors and accidents using technology.

Topics covered include: Consideration of human characteristics in the requirement determination for the design of systems, organizations, facilities, processes, and products to enable human-centered design which considers human abilities, limitations, and acceptance.

020IITES2	Industrial IoT	4 Cr.

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

020PRNES4	Industrial Process and Control	4 Cr.

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

020INDES2	Innovation and Design Thinking	2 Cr.

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

020GSTES3	Inventory Control	4 Cr.

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

020MNGES4	Management	4 Cr.

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

020PF1ES3	Manufacturing Processes 1	4 Cr.

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

020PF2ES4	Manufacturing Processes 2	4 Cr.

This course covers the main manufacturing processes used in the industry for different types of materials (metal, glass, plastics, rubber, composites, ceramics). It explains the techniques applied during the preparation of a product, from the fabrication of the primary parts to the finishing of the final assembled product. In addition to the "material removal processes" explained in the "Manufacturing Processes 1" course, the covered topics include: solidification processes (casting, molding …), particulate processing, deformation of metals and plastics, and assembly operations (welding, over molding, threading...) Also, the course describes some advanced processes and technologies such as waterjet cutting, laser cutting, layer-design, 3D printing and nanotechnologies.
Prerequisite: Manufacturing Processes 1 (020PF1ES3).

020MNSES5	Manufacturing Systems	4 Cr.

This course introduces basic manufacturing systems from both design and operations perspectives. Topics covered include: Deterministic models for single and parallel machines, flow shops and flexible shops are presented. Topics include: assembly lines, transfer lines, production scheduling and flexible manufacturing systems. Additional topics related to current manufacturing technology and challenges are also covered in this course
Prerequisites: Work Methods and Analysis (020MEAES1), Production Control (020GEPES3).

020STMES1	Mechanical Structures	6 Cr.

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

020MMIES5	Mechatronics and Intelligent Machines	4 Cr.

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

020PRMES4	Multidisciplinary Project	6 Cr.

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

020ROOES4	Operations Research and Optimization	6 Cr.

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

020GEPES3	Production Control	6 Cr.

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

020CPLES4	Production Chain and Logistics	4 Cr.

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

020GPRES2	Project Management	4 Cr.

This course focuses on equipping students with the essential skills and techniques needed for successful project management, ensuring projects are completed on time, within budget, and to a high standard. It aims to teach students effective strategies for managing project budgets, schedules, and quality, while exposing them to a variety of practical tools and methodologies for overseeing projects they are currently working on or will be responsible for in the future.

020GEQES2	Quality Control & Reliability	6 Cr.

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

020BDRES2	Relational Databases	4 Cr.

Topics covered include: 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.

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, students 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 program 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 students 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. Topics covered include: Concepts of dynamic response

related to vibration and motion planning. The principles of operation of various actuators, pneumatic, magnetic, piezoelectric, linear, stepper, etc. Advanced feedback mechanisms using software executing in an embedded system. The concepts for real-time processor programming. Image processing and artificial intelligence. Neural networks and advanced controllers, along with their implementation using microcontrollers and/or software based (MATLAB, LabVIEW, etc.).

020CEIES3	Sensors and Instrumentation	4 Cr.

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

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

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

020STAES1	Statistics	4 Cr.

Topics covered include: 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).

020SSYES5	Systems Simulation	6 Cr.

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

020MEAES1	Work Methods and analysis	6 Cr.

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

020WRNES1	Work Ready Now	2 Cr.

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