BACHELOR OF ENGINEERING IN COMPUTER AND COMMUNICATIONS ENGINEERING

Main Language of Instruction:
French ☑ English ☑ Arabic ○

Campus where the Program is Offered: CST

OBJECTIVES

The Bachelor of Engineering in Computer and Communications Engineering aims to equip students to:

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

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

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

PROGRAM REQUIREMENTS

180 credits: Required courses (150 credits), Institution's elective courses (26 credits), Open elective courses (4 credits).
USJ General Education Program (26 credits – may be 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.)
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 concentration in Software Engineering:
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 concentration in Telecommunication Networks:
Digital Signal Processing (4 Cr.)
Information Theory and Coding (4 Cr.)
Microprocessor Systems (4 Cr.)
Mobile Networks (4 Cr.)
Network Engineering (4 Cr.)
Optical Systems and Networks (4 Cr.)
Performance of Computer Systems and Networks (4 Cr.)
Quality of Service in Networks (4 Cr.)
Secured Enterprise Networks (4 Cr.)
Waveguides and Antennas (4 Cr.)
Wireless Communications (4 Cr.)

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

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

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

Institution's Elective Courses (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.)
Generative AI (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 concentration in Software Engineering (16 Cr.)	
020ADPES3	Analysis and Design of Information Systems	4
020IA2ES4	Artificial Intelligence	4
020AROES3	Computer Architecture	4
020MCOES3	Design Patterns	4
	For the concentration in Telecommunication Networks (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 concentration in Software Engineering (12 Cr.)	
020PCOES4	Compiler Principles	4
020APDES4	Distributed Applications	4
020SSEES4	Operating Systems	4
	For the concentration in Telecommunication Networks (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 concentration in Software Engineering (16 Cr.)	
020VIRES5	Computer Virology	4
020IAEES5	Enterprise Application Integration	4
020PPLES5	Parallel Programming	4
020GLOES5	Software Engineering	4
	For the concentration in Telecommunication Networks (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 semesters of the Cisco CCNA Routing & Switching curriculum. It focuses on the architecture, components and operation of routers and switches in a larger and more complex network by presenting the configuration of this equipment for advanced functionality. Emphasis is also placed on WAN technologies and network services required by converged applications in a complex network, providing an understanding of network device selection criteria and WAN technologies that meet network requirements.
Prerequisite: Network Routing and Switching (020RCOES2)

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, etc.), Zener diode (regulation), Light-emitting diode. 3) Bipolar transistor: DC operation (I-V characteristics, Biasing, Load line), AC operation (amplifier circuits), synthesis of amplifier circuits, Bipolar transistor as switches. 4) MOSFET transistors: I-V characteristics, resistive operation and amplification. 5) Operational amplifier (OA): behavioral model and imperfections, application circuits (Inverting/Non-inverting amplifiers, Integrators, Voltage Follower, Active filters). 6) Comparator: characteristics, performance & limitations, applications.
Prerequisite: Linear Electrical Systems and Networks (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 objective of this course is to focus on the practical aspect of IT in a company whether it has its own IT system, on the cloud, or hybrid. The scope covers Datacenter, Servers, Storage, Network & Security, Information Systems design and Build, Information Systems Operations, Application

Landscape, Integration Layer, Procurement & Budget and building an internal Cloud. It includes an overview, best practices and pitfall, and a series of practical use cases that illustrate real life scenarios.

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. The course is aimed at students destined to work in public or private companies and in all fields. Its objective is to create awareness for the need of ethics, which is becoming inescapable today, given current trends towards sustainable development, the dissemination of information to stakeholders and transparent competition. It also offers prospective engineers the opportunity to understand business issues from an analytical perspective and to distinguish themselves by their professionalism and informed attitude about ethics. Finally, students will be more alert to the entrepreneurial approaches and the ethical reflection that accompanies it.

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 Communication Skills 2 Cr.

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

020PCOES4 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 to threats and attacks – services: authentication, integrity, confidentiality, non-repudiation – security mechanisms and technics: algorithms, smart cards, key management, certificates, etc. – recommendations and law – security protocols: PKCS, PKI, X509, SSH, ISO9735, SSL, S/Mime – API – practical cases: e-banking, e-commerce, e-notary, health, archeology, etc.

020SDAES3 Data Structures and Algorithms 4 Cr.

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

020MCOES3 Design Patterns 4 Cr.

This course covers the principles of Object-Oriented Programming in Java. It details the 23 design patterns of the book: Design Patterns: Elements of Reusable Object-Oriented Software (GOF) and shows how and when to use creational/structural/behavioral design patterns in a greenfield project or in refactoring a brownfield project. It introduces the UML modeling language for modeling object-oriented solutions as well as covering the main java

libraries and packages for handling multithreading, input/outputs and network communications. Finally, it initiates students to the use of documentation, and application monitoring (profiling, logs, and traces) tools.

020ELNES2 Digital Electronics 6 Cr.

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

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 I (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 in groups of 2 to 4 students, aiming to deliver practical design experience in computer and communications engineering under the supervision and approval of a faculty member. Students must define the project, specify its objectives, perform a state of the art of the studies topic, establish the project specifications and select a design method. In this project, students must apply the knowledge acquired throughout their academic years of study and provide a final product that has gone through all stages of design, modeling, analysis, testing and evaluation. A final report and two oral presentations are the main deliverables of the project.
Prerequisite: Having validated 150 credits

020PFSES3 Functional Programming 4 Cr.

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

020GAIES5 Generative AI 4 Cr.

Generative AI is a course designed to offer a comprehensive understanding of generative models in AI, like ChatGPT and diffusion models, and the practical application of these technologies. The course emphasizes open-source models, training techniques, and fine-tuning practices.

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 network analysis; optimization and linear programming; numerical tools for solving optimization problems.

020ISSES5 Information Security Standards and Best Practices 4 Cr.

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

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 also covers the channel coding techniques used to improve the performance of a communications system like block codes, the algebraic structure of cyclic codes, BCH codes, Reed Solomon codes, convolutional codes, LDPC codes, Turbo codes and Polar codes.
Prerequisite: Analog and Digital Communications (020CONES3)

020INDES2 Innovation and Design Thinking 2 Cr.

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

020EEIES4 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 on the Internet – Utility and demand models – Pricing models on 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 course offers a set of practical exercises that introduces students to the implementation of a network and configuration of the switching equipment; The use of network simulation tools and protocol analysis; Socket programming. This is a blended course offering the Semester 1 of Cisco CCNA Routing & Switching online material.

020ISDES3 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 autonomously learn from examples. The main research topics in ML include: Computer Vision (CV), Natural Language Processing (NLP) and precision medicine for personalized treatments. The main goal of this course is to acquire a basic understanding of ML algorithms as well as hands-on ML engineering experience with regards to its application to realistic datasets through Python implementations that make use of state-of-the-art libraries such as Scikit-learn, Tensorflow and Keras.

020MNGES5 Management 2 Cr.

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

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, 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 learn the essential concepts, tools, and techniques required to develop mobile applications for popular platforms such as Android and iOS. Through hands-on projects and real-world examples, students gain practical experience in designing, developing, and deploying mobile applications.
By the end of the course, students will have the knowledge and skills to independently develop and deploy mobile applications for various platforms. They will have a strong foundation in mobile app development, enabling them to pursue careers as mobile app developers or entrepreneurs in the app industry.

020REMES4 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 concentrations where each student participates in the execution of a task related to their field. It aims to provide hands-on design experience, strengthen their analysis capacity, and develop their communication skills and teamwork ability. In this project, students must apply the knowledge acquired throughout their academic years of study and provide a final product that has gone through all stages of design, modeling, analysis, testing and evaluation. A final report and an oral presentation are the main deliverables of the project.

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 II (020AN2CI3)) and (Linear Algebra (020LALNI2) or Algebra I (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 II (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 – 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 also covers topics such as signal integrity, parasitic, coupling, controlled impedance and power distribution. The course also includes a project realization of a complex circuit using Proteus software.
Prerequisite: Digital Electronics (020ELNES2)

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

020QOSES5 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. It also describes many specification tools used for the analysis of functional and non-functional requirements. It explains the DRY, KISS and SOLID principles mainly its advanced object-oriented design concepts (OCP, LSP, etc.), and covers all the UML diagrams for OO modeling. It also explains the CRC Card design method adopted by the eXtreme Programming methodology. It demonstrates the need for continuous refactoring and explains refactoring techniques at a surgical, tactical and strategic level. It also describes the process to follow in order to succeed in refactoring, starting by configuring and using configuration/source code management tools like Git/GitHub, as well as testing and bug management software, then, by evaluating the quantitative and qualitative code quality in order to find eligible refactoring candidates and finally by executing and validating the refactoring step. This course describes the testing pyramid and details unit/integration/functional and non-functional testing, while stressing on the need for Test Driven development using JUnit. It compares methods that can be used to estimate the cost of a software. It explains UI/UX to-do and not-do basics by studying the different cases of standalone, and web applications focusing on accessibility issues. Finally, it introduces DevOps principles and raises students' awareness about SAAS development and the value of IT automation.

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

Micro/nano satellite mission, orbits design and analysis, subsystem scheme, micro/nano satellite configuration design, system performance determination and analysis, reliability and safety analysis technical processes of the satellite development, attitude system determination and control, design of the micro/nano satellite integrated electronic system, architecture of micro/nano satellite integrated electronic and relevant technical specifications, concept of micro/nano satellite testing description, ground station types and related software, STK tracker software, design and implement (tabletop) a nanosatellite type Cubesat 1U using commercial components and boards.
Prerequisites: Analog Electronics (020ELAES1) and Mechanics I (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 III (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 frontend (client-side) and the backend (server-side). It is, in fact, a hands-on web programming course where a MongoDB, Express, React and Node (MERN) web application is gradually designed and implemented as the course progresses.
The course first introduces the basic languages used for web development, namely HTML, CSS and JavaScript. They are followed by the introduction of the Twitter Bootstrap web framework and the quick implementation of several web pages using this framework. Afterwards, the React framework along with its underlying Flux architecture is explained. A React Single Page Application (SPA) is then implemented. At this stage, the frontend has been fully implemented while the backend is still mocked using a simulated JSON-Server. This mock backend is then replaced by a fully functional REST API implemented using Node.js, the Express framework and the MongoDB database. This REST API is then tested using Postman before it is integrated with the react frontend, concluding the implementation of a full stack MERN web application.
Each part of this full stack MERN application can now be deployed on a cloud provider such as Heroku to provide Software as a Service (SaaS) functionalities. We then introduction Google Firebase which provides Backend as a Service (BaaS) functionalities to discharge the developer from implementing a backend. We then conclude with an initiation to Angular as a possible alternative to React for building enterprise full stack MongoDB, Express, Angular and Node (MEAN) web applications.

020ADWES4 Windows System Administration 4 Cr.

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

020CSFES3 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.