BACHELOR OF ENGINEERING IN COMPUTER AND COMMUNICATIONS ENGINEERING

Concentrations:

Artificial Intelligence, Software Engineering, Telecommunication Networks

Main Language of Instruction:
French ☑ English ○ Arabic ○

Campuses Where The Program Is Offered: Regular Preparatory: CST, CLN, CLS, CZB – Honors Preparatory and Bachelor of Engineering: CST

OBJECTIVES

Objectives – Honors Preparatory Computer and Communications Engineering
The Computer and Communications Engineering program enables students to:

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

Objectives – Regular Preparatory Computer and Communications Engineering
The Computer and Communications Engineering program enables students to:

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

Objectives – Bachelor of Engineering in Computer and Communications Engineering
The Bachelor of Engineering in Computer and Communications Engineering enables students to:

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

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

Competencies – Honors Preparatory Computer and Communications Engineering

- 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.

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PROGRAM REQUIREMENTS

Students are required to choose either the Honors Preparatory track or the Regular Preparatory track. Once the two years of the chosen track are completed, they join the three-year Bachelor of Engineering program.

Honors Preparatory Computer and Communications Engineering
120 credits: Required courses (120 credits including 10 credits for USJ General Education Program)

Required Courses (120 Cr.)
Algebra 1 (6 Cr.). Algebra 2 (6 Cr.). Algebra 3 (4 Cr.). Analysis 1 (4 Cr.). Analysis 2 (6 Cr.). Analysis 3 (4 Cr.). Discrete Mathematics (6 Cr.). General Analysis (6 Cr.). Advanced General Chemistry (4 Cr.). Electromagnetism (4 Cr.). General Chemistry (4 Cr.). General Chemistry Laboratory (2 Cr.). Magnetic Induction (2 Cr.). Mechanics 1 (6 Cr.). Mechanics 2 (4 Cr.). Physical Signals (6 Cr.). Physics Laboratory 1 (2 Cr.). Physics Laboratory 2 (2 Cr.). Quantum Physics (2 Cr.). Thermodynamics 1 (6 Cr.). Thermodynamics 2 (2 Cr.). Wave Optics (2 Cr.). Programming 1 (4 Cr.). Programming 2 (4 Cr.). Programming 3 (2 Cr.). Digital Systems Design (4 Cr.). Linear Electrical Systems and Networks (4 Cr.). Signal Processing (2 Cr.). Supervised Personal Initiative Work (2 Cr.). Engineering at the Service of the Community (2 Cr.). French and Philosophy 1 (2 Cr.). French and Philosophy 2 (2 Cr.). USJ Values in Daily Life (2 Cr.).

Regular Preparatory Computer and Communications Engineering
120 credits: Required courses (116 credits), Open elective courses (4 credits), USJ General Education Program (10 credits - may be part of the above categories)

Required Courses (116 Cr.)
Analysis 1 (4 Cr.). Analysis 2 (6 Cr.). Bilinear Algebra and Geometry (6 Cr.). Differential Calculus (6 Cr.). Discrete Mathematics (6 Cr.). General Analysis (6 Cr.). Linear Algebra (8 Cr.). Probability (4 Cr.). Supplemental Mathematics (2 Cr.). Electromagnetism (4 Cr.). General Chemistry (4 Cr.). Magnetic Induction (2 Cr.). Mechanics 1 (6 Cr.). Mechanics 2 (4 Cr.). Physical Signals (6 Cr.). Physics Laboratory 1 (2 Cr.). Physics Laboratory 2 (2 Cr.). Thermodynamics 1 (4 Cr.). Wave Optics (2 Cr.). Programming 1 (4 Cr.). Programming 2 (4 Cr.). Programming 3 (4 Cr.). Digital Systems Design (6 Cr.). Introduction to Engineering Projects (2 Cr.). Linear Electrical Systems and Networks (6 Cr.). MATLAB (2 Cr.). Engineering at the Service of the Community (2 Cr.). USJ Values in Daily Life (2 Cr.).

Open Elective Courses (4 Cr.)

Bachelor of Engineering in Computer and Communications Engineering
180 credits: Required Courses-Common Core (102 credits), Required courses per concentration (44 credits), Institution's elective courses (30 credits), Open elective courses (4 credits) and USJ General Education Program (26 credits - may be part of the above categories).

Fundamental Courses (176 Cr.)
Required Courses-Common Core (102 Cr.)
Accounting (4 Cr.). Analog and Digital Communications (6 Cr.). Analog Electronics (6 Cr.). Business Ethics (4 Cr.). Business Law (2 Cr.). Communication Skills (2 Cr.). Data Structure and Algorithms (4 Cr.). Digital Electronics (6 Cr.). Graph Theory and Operational Research (4 Cr.). Innovation and Design Thinking (2 Cr.). Introduction to Data Networks (6 Cr.). Management (2 Cr.). Network Routing and Switching (4 Cr.). Object-Oriented Programming (6 Cr.). Project Management (4 Cr.). Relational Databases (4 Cr.). Signal Theory (4 Cr.). Statistics (4 Cr.). Unix System Administration (4 Cr.). Corporate Internship (2 Cr.). Multidisciplinary Project (6 Cr.). Final Year Project (16 Cr.).

Required Courses-Concentration: Artificial Intelligence (44 Cr.)
Artificial Intelligence (4 Cr.). Computer Architecture (4 Cr.). Computer Vision (4 Cr.). Generative AI (4 Cr.). Machine Learning (4 Cr.). Machine Learning Operations (4 Cr.). Mining Massive Datasets (4 Cr.). Natural Language Processing (4 Cr.). NoSQL Databases (4 Cr.). Optimization for AI (4 Cr.). Parallel Programming (4 Cr.).

Required Courses-Concentration: Software Engineering (44 Cr.)
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.).

Required Courses-Concentration: Telecommunication Networks (44 Cr.)
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.).

Institution's Elective Courses (30 Cr.), to be chosen from the following list:
to be selected from the required courses of the other two concentrations, or from the list below:
English (4 Cr.). Advanced Databases (4 Cr.). Advanced Microcontroller Systems (4 Cr.). Advanced Networking and WAN Technologies (4 Cr.). AI in Marketing (4 Cr.). Blockchain and Cryptocurrency (4 Cr.). Cloud and Digital Transformation (4 Cr.). Continuous Integration and Deployment (4 Cr.). Cryptography (4 Cr.). Effective Programming (4 Cr.). Embedded Systems (4 Cr.). Entrepreneurship (2 Cr.). Ethical Hacking (4 Cr.). Functional Programming (4 Cr.). Information Security - Standards and Best Practices (4 Cr.). Information Technology (IT) at Work (4 Cr.). Internet Ecosystem and Evolution (4 Cr.). Internet of Things Technologies (4 Cr.). Introduction to Data Science (4 Cr.). Microwave Links and Circuits (4 Cr.). Mixed-Signal IC Design (4 Cr.). Mobile Applications Development (4 Cr.). Numerical Methods (4 Cr.). 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.). Software Quality Assurance (4 Cr.).

Open Elective Courses (4 Cr.)

USJ General Education Program (10 out of 36 Cr.) - Honors Preparatory Computer and Communications Engineering, Regular Preparatory Computer and Communications Engineering
26 additional credits are validated in the Department of Computer and Communications Engineering

Code	Course Name	Credits
	HUMANITIES	**4**
064VALEL1	USJ Values in Daily Life	2
	Civic Engagement and Citizenship	**2**
020GSCNI1	Engineering at the Service of the Community	2
	QUANTITATIVE TECHNIQUES	**6**
020MADNI1	Discrete Mathematics	6

USJ General Education Program (26 out of 36 Cr.) - Bachelor of Engineering in Computer and Communications Engineering

10 additional credits are validated in the Department of Preparatory Classes

Code	Course Name	Credits
	ENGLISH OR OTHER LANGUAGE	**4**
020ANGES4	English	4
	ARABIC	**4**
	Arabic Language and Culture	**2**
435LALML2 435LALAL2 435LRCTL2	One Arabic Culture and Language course to be selected among: Arabic Language and Media Arabic Language and Arts Arabic Language: Contemporary Novel, Cinema, and Theater	2
	Other Course Taught in Arabic	**2**
020DRAES5	Business Law	2
	HUMANITIES	**4**
	Ethics	**4**
020ETHES3	Business Ethics	4
	SOCIAL SCIENCES	**6**
	Professional Integration and/or Entrepreneurship	**2**
020ENTES1 020WRNES1	One Institution's elective course to be selected between: Entrepreneurship Work Ready Now	2
	Other Social Sciences Course	**4**
020GPRES2	Project Management	4
	COMMUNICATION TECHNIQUES	**8**
020TCOES2	Communication Skills	2

020PRMES4	Multidisciplinary Project	2 out of 6
020PFEES6	Final Year Project	4 out of 16

SUGGESTED STUDY PLAN

Students are required to choose either the Honors Preparatory track or the Regular Preparatory track. Once the two years of the chosen track are completed, they join the three-year Bachelor of Engineering program.

Semester 1

Code	Course Name	Credits
	Required Courses - Honors Preparatory Computer and Communications Engineering	
020MADCI1	Discrete Mathematics	6
020GSCCI1	Engineering at the Service of the Community	2
020ANGCI1	General Analysis	6
020CHGCI1	General Chemistry	4
020MC1CI1	Mechanics 1	6
020SPHCI1	Physical Signals	6
	Total	**30**
	Required Courses - Regular Preparatory Computer and Communications Engineering	
020MADNI1	Discrete Mathematics	6
020GSCNI1	Engineering at the Service of the Community	2
020ANGNI1	General Analysis	6
020CHGNI1	General Chemistry	4
020MC1NI1	Mechanics 1	6
020SPHNI1	Physical Signals	6
020CMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Name	Credits
	Required Courses - Honors Preparatory Computer and Communications Engineering	
020AL1CI2	Algebra 1	6
020AA1CI2	Analysis 1	4
020FR1CI2	French and Philosophy 1	2
020TCGCI2	General Chemistry Laboratory	2
020INMCI2	Magnetic Induction	2
020PP1CI2	Physics Laboratory 1	2
020IF1CI2	Programming 1	4
020TH1CI2	Thermodynamics 1	6
	Total	**28**
	Required Courses - Regular Preparatory Computer and Communications Engineering	

020AA1NI2	Analysis 1	4
020ALNNI2	Linear Algebra	8
020INMNI2	Magnetic Induction	2
020PP1NI2	Physics Laboratory 1	2
020IF1NI2	Programming 1	4
020TH1NI2	Thermodynamics 1	4
	Open Elective Course	2
	Total	**26**

Semester 3

Code	Course Name	Credits
	Required Courses - Honors Preparatory Computer and Communications Engineering	
020CHACI3	Advanced General Chemistry	4
020AL2CI3	Algebra 2	6
020AN2CI3	Analysis 2	6
020EMECI3	Electromagnetism	4
020FR2CI3	French and Philosophy 2	2
020MC2CI3	Mechanics 2	4
020PP2CI3	Physics Laboratory 2	2
020IF2CI3	Programming 2	4
020TRSCI3	Signal Processing	2
020OPTCI3	Wave Optics	2
	Total	**36**
	Required Courses - Regular Preparatory Computer and Communications Engineering	
020AN2NI4	Analysis 2	6
020ALBNI3	Bilinear Algebra and Geometry	6
020EMENI3	Electromagnetism	4
020MC2NI3	Mechanics 2	4
020PP2NI3	Physics Laboratory 2	2
020PRBNI4	Probability	4
020IF2NI3	Programming 2	4
020OPTNI3	Wave Optics	2
	Total	**32**

Semester 4

Code	Course Name	Credits
	Required Courses - Honors Preparatory Computer and Communications Engineering	
020AL3CI4	Algebra 3	4
020AN3CI4	Analysis 3	4
020TEDCI4	Digital Systems Design	4
020SRLCI4	Linear Electrical Systems and Networks	4

020IF3CI4	Programming 3	2
020PHQCI4	Quantum Physics	2
020TIPCI4	Supervised Personal Initiative Work	2
020TH2CI4	Thermodynamics 2	2
064VALEL1	USJ Values in Daily Life	2
	Total	**26**
	Required Courses - Regular Preparatory Computer and Communications Engineering	
020CDFNI4	Differential Calculus	6
020TEDNI4	Digital Systems Design	6
020PIINI4	Introduction to Engineering Projects	2
020SRLNI4	Linear Electrical Systems and Networks	6
020MATNI4	MATLAB	2
020IF3NI4	Programming 3	4
064VALEL1	USJ Values in Daily Life	2
	Open Elective Course	2
	Total	**30**

Semester 5

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Computer and Communications Engineering-Common Core	
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 6

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Computer and Communications Engineering-Common Core	
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 Course	2

	Total	**32**

Semester 7

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Computer and Communications Engineering-Common Core	
020ETHES3	Business Ethics	4
020SDAES3	Data Structures and Algorithms	4
020INDES2	Innovation and Design Thinking	2
	Institution's Elective Courses	8
	Required Courses-Concentration: Artificial Intelligence	
020IA2ES4	Artificial Intelligence	4
020AROES3	Computer Architecture	4
020NLPES3	Natural Language Processing	4
020NQLES3	NoSQL Databases	4
	Required Courses-Concentration: Software Engineering	
020ADPES3	Analysis and Design of Information Systems	4
020IA2ES4	Artificial Intelligence	4
020AROES3	Computer Architecture	4
020MCOES3	Design Patterns	4
	Required Courses-Concentration: Telecommunication Networks	
020TNSES3	Digital Signal Processing	4
020CSFES3	Wireless Communications	4
020SMPES3	Microprocessor Systems	4
020PGAES3	Waveguides and Antennas	4
	Total	**34**

Semester 8

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Computer and Communications Engineering-Common Core	
020PRMES4	Multidisciplinary Project	6
	Open Elective Course	2
	Institution's Elective Courses	12
	Required Courses-Concentration: Artificial Intelligence	
020CVNES4	Computer Vision	4
020MLRES4	Machine Learning	4
020MMDES4	Mining Massive Datasets	4
	Required Courses-Concentration: Software Engineering	4
020PCOES4	Compiler Principles	4
020APDES4	Distributed Applications	4
020SSEES4	Operating Systems	4
	Required Courses-Concentration: Telecommunication Networks	
020REMES4	Mobile Networks	4
020SYOES4	Optical Systems and Networks	4

020PSRES4	Performance of Computer Systems and Networks	4
	Total	**32**

Semester 9

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Computer and Communications Engineering	
020CMPES5	Accounting	4
020DRAES5	Business Law	2
020STGES5	Corporate Internship	2
020MNGES5	Management	2
	Institution's Elective Course	8
	Required Courses-Concentration: Artificial Intelligence	
020GAIES5	Generative AI	4
020MLOES5	Machine Learning Operations	4
020PPLES5	Parallel Programming	4
020OAIES5	Optimization for AI	4
	Required Courses-Concentration: Software Engineering	
020VIRES5	Computer Virology	4
020IAEES5	Enterprise Application Integration	4
020PPLES5	Parallel Programming	4
020GLOES5	Software Engineering	4
	Required Courses-Concentration: Telecommunication Networks	
020TICES5	Information Theory and Coding	4
020IDRES5	Network Engineering	4
020QOSES5	Quality of Service in Networks	4
020RESES5	Secured Enterprise Networks	4
	Total	**34**

Semester 10

Code	Course Name	Credits
	Required Courses - Bachelor of Engineering in Computer and Communications Engineering	
020PFEES6	Final Year Project	16
	Total	**16**

COURSE DESCRIPTION

Honors Preparatory Computer and Communications Engineering

020CHACI3 Advanced General Chemistry 4 Cr.

This course provides students with the basic principles of chemical thermodynamics as well as electrochemistry including the laws of thermodynamics; enthalpy, entropy, internal energy, free energy, chemical potential, phase equilibria; equilibrium constant; characterization of the intensive state of a system in equilibrium: variance of a system in equilibrium. optimization of a chemical process; overvoltage: current-potential curves; spontaneous transformations; batteries and electrolyzers; mixed potential, corrosion potential, corrosion current intensity, uniform corrosion in acidic or neutral oxygenated medium; differential corrosion by heterogeneity of the support or the environment; protection against corrosion.
Prerequisite: General Chemistry (020CHGCI1).

020AL2CI3 Algebra 2 6 Cr.

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

020AL3CI4 Algebra 3 4 Cr.

This advanced course is divided into two main parts. The first part focuses on inner product spaces, exploring concepts such as inner products, orthogonal vectors, orthonormal bases, and isometry in 2 and 3-dimensional Euclidean spaces. This section also delves into the study of symmetric endomorphisms and orthogonal matrices. The second part of the course introduces probability theory, including probability spaces, discrete random variables, probability distributions, and the law of large numbers. Building on the foundations of Algebra 2, this course provides students with a comprehensive understanding of these mathematical disciplines.
Prerequisites: Algebra 2 (020AL2CI3) - Analysis 1 (020AA1CI2).

020AA1CI2 Analysis 1 4 Cr.

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

020AN2CI3 Analysis 2 6 Cr.

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

020AN3CI4 Analysis 3 4 Cr.

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

020TEDCI4 Digital Systems Design 4 Cr.

This course provides students with the opportunity to familiarize themselves with various methods of designing simple digital systems. They will learn how to decompose a function into combinational and sequential blocks, and discover techniques for automating industrial processes based on specifications. The course content covers essential concepts such as number systems and codes, combinational and sequential logic, logical functions, and integrated logic circuits. Students will also explore topics including the Morgan's theorem, Karnaugh maps, flip-flops, synchronous and asynchronous binary counters/decoders, and shift registers. Practical work will be conducted to apply these concepts.

020MADCI1 Discrete Mathematics 6 Cr.

This course covers the following: Logic and reasoning, Set theory, Applications, Binary relations, Algebraic calculations, Complex numbers, Integer arithmetic, Polynomials.

020EMECI3 Electromagnetism 4 Cr.

This course starts with a separate study of the stationary case of the electric and the magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and the circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell's equations. After a presentation of the Maxwell equations and the electromagnetic (EM) energy, attention is focused on the propagation of EM waves in vacuum, in conductors, in plasma and far away from an EM oscillating dipole.
Prerequisites: Physical Signals (020SPHCI1) - General Analysis (020ANGCI1).

020GSCCI1 Engineering at the Service of the Community 2 Cr.

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

020FR1CI2 French and Philosophy 1 2 Cr.

This course is offered to students in Higher Mathematics - Competition Section (Mathématiques supérieures - section Concours) to prepare them for the written French test in the admission competition for polytechnic schools (Filière Universitaire Internationale-Formation Francophone FUI-FF). Its objective is to provide students with the academic and didactic tools necessary for success in the admission test.

020FR2CI3 French and Philosophy 2 2 Cr.

This subject is offered to students in Advanced Mathematics - Competition Section (Mathématiques spéciales - section Concours) to prepare them for the written French test in the admission competition for polytechnic schools (Filière Universitaire Internationale-Formation Francophone FUI-FF). Its objective is to provide students with the academic and didactic tools necessary for success in the admission test.

020ANGCI1 General Analysis 6 Cr.

This course covers a set of real numbers, real functions, trigonometric functions, logarithmic functions, power functions, inverse trigonometric functions, hyperbolic functions, linear first order differential equations, second order differential equations with constant coefficients, real and complex sequences, limits and continuity of real functions, differentiability, Rolle's Theorem, and applications.

020CHGCI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric and conductometric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well

as titration by oxidation-reduction reaction are covered. Students will also learn the concept of heterogeneous equilibrium in aqueous solution, the effect of the common ion and of complexation on solubility, complexation reactions and the influence of pH on solubility. Finally, this course allows analyzing potential-pH diagrams through examples along vertical and horizontal lines.

020TCGCI2 General Chemistry Laboratory 2 Cr.

This course focuses on the comprehension of hazards and risks, as well as the identification of relevant safety guidelines. It aims to enhance students' knowledge regarding laboratory procedures, techniques, and safety protocols. Additionally, the course aims to develop students' skills in qualitative chemical analysis and titration of various mineral solutions, including acids, alkaline solutions, and precipitation reactions. Furthermore, students will learn to verify theoretical information through the determination of concentrations using electrochemical analysis methods such as spectrophotometric analysis. This course also familiarizes students with the equipment used in each laboratory session and establishes a strong foundation for data interpretation.
Prerequisite: General Chemistry (020CHGCI1).

020SRLCI4 Linear Electrical Systems and Networks 4 Cr.

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

020INMCI2 Magnetic Induction 2 Cr.

This course introduces students to the magnetic field beyond the descriptive approach studied in high school. It covers practical applications such as compasses, electric motors, alternators, transformers, speakers, induction plates, and radio-frequency identification. The course also presents the concept of magnetic flux and generalizes the magnetic dipole of a current circuit to magnets.

020MC1CI1 Mechanics 1 6 Cr.

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

020MC2CI3 Mechanics 2 4 Cr.

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

020SPHCI1 Physical Signals 6 Cr.

The course is concerned with a wide range of concepts already introduced at high school: periodic signals, spectrums, electrical energy, Ohm's law, Joule's law, lenses, wave length, light spectrum, numerical signal, travelling wave, diffraction, interferences, Doppler effect, Newton's law, mechanical energy, harmonic oscillator. It assures a smooth transition toward a more quantitative physics than the one seen at high school.

020PP1CI2 Physics Laboratory 1 2 Cr.

This practical work course is designed to bridge the gap between theoretical knowledge and practical application in the field of electrical engineering and physics. Throughout the course, students will engage in hands-on activities to gain a deeper understanding of various concepts. The key topics covered include resonance in RLC circuits, system analysis, circuit measurements, mechanics and motion, LabVIEW software, fields and characteristics, oscilloscope applications, Single-Degree-of-Freedom Oscillator, focal measurement, and Optical Systems. Overall, this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts.

020PP2CI3 Physics Laboratory 2 2 Cr.

This course allows students to solidify their theoretical knowledge by putting it into practice through a variety of topics. They will have the opportunity to explore areas such as electrical circuits, linear filters, Fourier analysis, frequency analysis, the Thomson tube, thermal conduction, the Stefan-Boltzmann law, the oscillator with two degrees of freedom, diffraction and interference, as well as polarization.
Prerequisite: Physics Laboratory 1 (020PP1CI2).

020IF1CI2 Programming 1 4 Cr.

This course covers the hardware components of a computer and the basic concepts of high-level programming using Python. The topics addressed include the computer's hardware components, algorithms, programming languages, Python and the IDLE environment, variables, arithmetic expressions and operators, primitive data types, input and output of data, built-in composite data types, simple statements, control statements, logical expressions, relational and logical operators, function definition and call, functions from external modules.

020IF2CI3 Programming 2 4 Cr.

This course covers LIFO and FIFO structures - Topics include a systematic study of existing sorting algorithms and how to calculate their time complexity. It also covers the basic concepts of object-oriented programming and their application to data abstraction by introducing the concepts of object instantiation, attributes, and methods. It also covers an introduction to relational databases.
Prerequisite: Programming 1 (020IF1CI2).

020IF3CI4 Programming 3 2 Cr.

This course covers the following: Ce Programming and algorithms with Categorical Abstract Machine Language (CAML) – variables, arithmetic expressions and operators, primitive data types, data input and output, built-in composite data types, simple statements, control statements, logical expressions, relational and logical operators, function definition and call, functions from external modules – array – dynamic programming – recursive structures (lists, trees) – LIFO – FIFO – complexity – graph – propositional logic – deterministic and non-deterministic finite state automata – regular expressions.
Prerequisite: Programming 1 (020IF1CI2).

020PHQCI4 Quantum Physics 2 Cr.

This course is concerned with two aspects of modern physics. The first based on the Schrodinger formulation of the wave mechanics and is treat simple but fundamental problems: free particle, particle in a single-step potential, tunnel effect, particle in a box and energy quantization. The second is an introduction to statistical thermodynamics where macroscopic properties of a system are to be related to its microscopic constituents. The Boltzmann factor is introduced for the isothermal atmosphere model then generalized to systems with a discreet spectrum of energy. Equipartition theorem is then used to evaluate heat capacity of gases and solids.
Prerequisite: Electromagnetism (020EMECI3).

020TRSCI3 Signal Processing 2 Cr.

This course aims to provide students with a thorough understanding of key concepts related to filtering of periodic signals and sampling. Students will have the opportunity to deepen their knowledge of linear filters,

understanding their operation and exploring the effects of first and second-order filters on a periodic signal. Special attention is given to the sampling process, with a detailed study of the Nyquist-Shannon theorem, which establishes the necessary conditions to avoid spectrum folding. Additionally, students will have the opportunity to become familiar with digital filtering.
Prerequisite: Physical Signals (020SPHCI1).

020TIPCI4 Supervised Personal Initiative Work 2 Cr.

This course enables students to undertake a personal project focused on the scientific and technological research process. Emphasis is placed on the necessity of asking preliminary questions, mirroring the common practice of scientists. The research process leads to the creation of conceptual and real-world objects, promoting knowledge construction. Students will conduct concrete research, analyze reality, and identify an issue related to the theme. Explanations are obtained through investigation using traditional tools and methods of scientific research. The objective is to encourage students to make discoveries on their own, leveraging their inventive and initiative-taking abilities, without undue ambition.

020TH1CI2 Thermodynamics 1 6 Cr.

This course focuses on the laws governing the macroscopic properties of a pure substance by covering fundamental concepts such as work, heat, and temperature. It is in this course that the student understands, describes, and quantifies the operation of thermodynamic machines such as engines, refrigerators, and heat pumps.

020TH2CI4 Thermodynamics 2 2 Cr.

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

020OPTCI3 Wave Optics 2 Cr.

This course covers the key concepts of the wave theory of light. It begins with the definition of spherical and plane waves, accompanied by a comprehensive exploration of key principles associated with them, such as optical path length, wave intensity, wavefront, wave trains, and coherence length. Special attention is given to light interference through wavefront division (Young's double-slit experiment) and through amplitude division (Michelson interferometer). The impact of extended and narrow-spectrum light sources is also examined. Furthermore, an analysis of the Fraunhofer diffraction phenomenon is presented, followed by a study of interference generated by multiple coherent waves and the use of a diffraction grating.
Prerequisite: Physical Signals (020SPHCI1).

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020AA1NI2 Analysis 1 4 Cr.

This course aims to develop a deep understanding of fundamental concepts in mathematical analysis and equip students with the ability to apply these tools to solve more advanced mathematical problems. It covers topics such as Taylor series expansions for approximating functions and studying their local behavior around a point. Students will also learn about anti-derivatives and improper integrals, gaining the skills to manipulate them effectively. Additionally, the course delves into the convergence or divergence of numerical series, teaching students how to determine convergence using specific criteria. Overall, these topics prepare students to tackle complex mathematical problem-solving tasks.

020AN2NI4 Analysis 2 6 Cr.

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

020ALBNI3 Bilinear Algebra and Geometry 6 Cr.

This course provides students with a solid understanding of fundamental concepts, including the reduction of endomorphisms, pre-Hilbert spaces and endomorphisms of Euclidean spaces. Throughout this course, students will develop proficiency in techniques for reducing matrices and endomorphisms, along with their practical applications such as calculating matrix powers, solving linear recurrent sequence systems and utilizing linear recurrent sequences to compute the matrix exponential. Additionally, the course examines pre-Hilbert spaces, placing emphasis on key notions such as the inner product, orthogonality and orthogonal projections. Students will learn how to apply these concepts in solving problems related to orthonormalization. Furthermore, the course covers the study of planar isometries, encompassing translations, rotations and reflections, as well as isometries in space. By engaging with these topics, students will acquire a strong foundation in bilinear algebra and the necessary skills to apply these concepts effectively in practical situations.
Prerequisite: Linear Algebra (020ALNNI2).

020CDFNI4 Differential Calculus 6 Cr.

This course is an in-depth exploration of differential equations and systems of ODEs. Fundamental concepts such as vector norms, subspaces, bases, and open and closed balls are thoroughly detailed. Then, students will explore the notions of convergence and equivalence between norms. The course also covers Topology by introducing fundamental concepts such as open and closed sets, adherent points, interior and boundary points. Then, a significant portion of the course is devoted to studying functions of several variables to explore concepts such as extrema and implicit functions. Finally, students will learn how to calculate double and triple integrals using various methods such as Cartesian, polar, and cylindrical coordinates. The concepts and techniques studied in this course are essential for developing advanced analytical skills and solving complex mathematical problems.
Prerequisite: General Analysis (020ANGNI1).

020TEDNI4 Digital Systems Design 6 Cr.

This course familiarizes students with various methods of designing simple digital systems. They will learn how to decompose a function into combinational and sequential blocks, and discover techniques for automating industrial processes based on specifications. The course content covers essential concepts such as number systems and codes, combinational and sequential logic, logical functions, and integrated logic circuits. Students will also explore topics including Morgan's theorem, Karnaugh maps, flip-flops, synchronous and asynchronous binary counters/decoders, and shift registers. Practical work will be conducted to apply these concepts.

020MADNI1 Discrete Mathematics 6 Cr.

This course covers the following: Propositional logic - Mathematical reasoning - Sets - Relations - Natural numbers, induction - Applications - Algebraic calculation - Binomial coefficient and Pascal triangle - Polynomials – Arithmetic.

020EMENI3 Electromagnetism 4 Cr.

This course begins with a distinct examination of the stationary electric and magnetic fields. Geometrical symmetries are used to benefit from the properties of the flux and circulation of a vector field. Stationary local equations are introduced as a special case of Maxwell's equations. Following the presentation of Maxwell's equations and the electromagnetic (EM) energy, attention is shifted to the propagation of EM waves in vacuum.
Prerequisites: General Analysis (020ANGNI1) - Physical Signals (020SPHNI1).

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

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

020ANGNI1 General Analysis 6 Cr.

This course covers the fundamental concepts of analysis, including limits, continuity, differentiation, sequences, sets of numbers, and differential equations. Its objective is to equip students with the necessary skills to effectively calculate limits, perform differentiation and solve linear differential equations of both first and second order. In addition, this course allows the development of mathematical reasoning skills. Students will learn to formulate coherent arguments, justify calculation steps and prove mathematical results. By the end of this course, students will have gained a solid foundation in analysis enabling them to pursue more advanced courses in mathematics, physics, and engineering.

020CHGNI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium as well as pH-metric titrations. In addition, notions about oxidants and reductants, the electrochemical cell, the type of electrodes, the calculation of the electromotive force and the capacity of the cell, the potential of the electrode through the Nernst equation as well as titration by oxidation-reduction reaction are covered. Students will also learn the concept of heterogeneous equilibrium in an aqueous solution, the effect of the common ion and of complexation on solubility, complexation reactions and the influence of pH on solubility. Finally, this course allows the analysis of potential-pH diagrams through examples along vertical and horizontal lines.

020PIINI4 Introduction to Engineering Projects 2 Cr.

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

020ALNNI2 Linear Algebra 8 Cr.

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

020SRLNI4 Linear Electrical Systems and Networks 6 Cr.

This course serves as an introduction to the fundamental principles of electrical engineering, focusing on the analysis of electric circuits. Students will delve into resistive network analysis, AC network analysis, transient analysis, and explore frequency response and system concepts. The use of Bode, Black, and Nyquist diagrams are extensively covered to provide a comprehensive understanding of electrical circuits.
Prerequisite: Physical Signals (020SPHNI1).

020INMNI2 Magnetic Induction 2 Cr.

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

020MATNI4 MATLAB 2 Cr.

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

020MC1NI1 Mechanics 1 6 Cr.

This course studies particle mechanics, a branch of physics that analyzes the motion of objects as dimensionless mass points. This course simplifies physical systems by ignoring object dimensions and internal structure, focusing only on mass and position in space. This course applies Newton's laws to describe the relationship between applied forces, mass, and motion. This course enables students to analyze particle motion based on forces, mass, and initial conditions, providing a foundation for advanced concepts in classical mechanics, including kinematics, dynamics, laws of motion, and energy.

020MC2NI3 Mechanics 2 4 Cr.

This course studies solid mechanics, a branch of mechanics that examines the motion and equilibrium of objects considered as rigid bodies. This course covers the laws of mechanics for systems, focusing on solids, and shows how to determine the center of mass and study translational and rotational motion around a fixed axis. This course provides the definition of force systems and derived laws, allowing students to apply static, dynamic, and energetic principles to solve complex mechanical problems.
Prerequisite: Mechanics 1 (020MC1NI1).

020SPHNI1 Physical Signals 6 Cr.

This course enables students to understand the core principles pertaining to linear circuits and signal propagation. Throughout the course, students will delve into key concepts such as harmonic oscillators, progressive waves, interference, the fundamental laws of electrokinetics, complex notations, impedances and admittances, as well as linear filters. By the end of the course, students will possess the essential knowledge and skills required to effectively analyze and resolve challenges within these domains.

020PP1NI2 Physics Laboratory 1 2 Cr.

This practical work course is designed to bridge the gap between theoretical knowledge and practical application in the field of electrical engineering and physics. Throughout the course, students will engage in hands-on activities to gain a deeper understanding of various concepts. The key topics covered include resonance in RLC circuits, system analysis, circuit measurements, mechanics and motion, LabVIEW software, fields and characteristics, oscilloscope applications, single-degree-of-freedom oscillator, focal measurement, and optical systems. Overall,

this practical work course is designed to equip students with the necessary skills to apply theoretical knowledge in real-world scenarios, fostering a comprehensive understanding of electrical engineering and physics concepts.

020PP2NI3 Physics Laboratory 2 2 Cr.

This course allows students to reinforce their theoretical knowledge through practical applications across a variety of topics. They will have the opportunity to explore areas such as electrical circuits, linear filters, Fourier analysis, frequency analysis, the Thomson tube, thermal conduction, the Stefan-Boltzmann law, the oscillator with two degrees of freedom, diffraction and interference, as well as polarization.
Prerequisite: Physics Laboratory 1 (020PP1NI2).

020PRBNI4 Probability 4 Cr.

This course enables students to develop an understanding of the probability theory. It is designed to equip students with the necessary skills to effectively calculate probabilities. Throughout this course, students are introduced to various aspects of probability, beginning with combinatorics. They will learn techniques such as combinations, permutations and arrangements. Furthermore, they will explore concepts that enhance the understanding and manipulation of probabilities on a countable set. This includes the monotone convergence theorem, Boole's inequality, conditioning, compound probabilities, total probabilities and Bayes' formula. Additionally, the course emphasizes the study of discrete random variables, enabling students to model and analyze random phenomena using probability distributions. Finally, students will explore continuous random variables, with a focus on an extensive examination of cumulative distribution functions, expectation and variance.
Prerequisite: Analysis 1 (020AA1NI2).

020IF1NI2 Programming 1 4 Cr.

This course introduces the universal computer and the basic concepts of high-level programming using Python. Topics include: computer hardware components, algorithms, programming languages, Python and the IDLE environment, variables, arithmetic expressions and operators, primitive data types, data input and output, built-in composite data types, simple statements, control statements, logical expressions, relational and logical operators, function definition and call, functions from external modules.

020IF2NI3 Programming 2 4 Cr.

This course allows the students to acquire advanced concepts of structured programming in Python. It also covers the basic concepts of object-oriented programming and their application to data abstraction and encapsulation by introducing the concepts of object instantiation, member visibility, inheritance, and polymorphism. Students will also learn how to create an ergonomic standalone graphical user interface using the standard tkinter library.
Prerequisite: Programming 1 (020IF1NI2).

020IF3NI4 Programming 3 4 Cr.

This course covers advanced programming concepts in Python. It includes a systematic study of existing sorting algorithms and how to calculate their time complexity. The course explores applying recursion to sorting algorithms with a recursive structure. It also covers file management for saving or reading structured or unstructured data, creating and manipulating relational databases, building command-line interfaces, using specialized libraries for scientific computing and data analysis, and connecting to remote sites to retrieve or submit data through programming interfaces (APIs).
Prerequisite: Programming 1 (020IF1NI2).

020CMTNI1 Supplemental Mathematics 2 Cr.

This course equips students with the necessary skills to solve elementary mathematical problems. They will learn key concepts such as composite and inverse functions, numerical sequences, circular functions, as well as definite and indefinite integrals. By studying composite and inverse functions, students will comprehend the relationships between different functions and learn to decompose and reconstruct more complex functions. Additionally, this course introduces numerical sequences, particularly arithmetic and geometric sequences. Another essential component of this course is the study of basic trigonometric functions: sine, cosine, and tangent. Finally, this

course covers definite and indefinite integrals by exploring their properties, the technique of integration by parts, the substitution method, and a fundamental application: calculating areas.

020TH1NI2 Thermodynamics 1 4 Cr.

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

064VALEL1 USJ Values in Daily Life 2 Cr.

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

020OPTNI3 Wave Optics 2 Cr.

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

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020CMPES5 Accounting 4 Cr.

This course covers the following: Definition of accounting, accounting process, accounting concepts, classification of accounts, rules of double entry accounting system, rules of journal, current assets, current liabilities. concepts of cost accounting, advantages of cost accounting, classification and elements of cost, preparation of cost sheet.

020BDAES3 Advanced Databases 4 Cr.

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

020SAMES4 Advanced Microcontroller Systems 4 Cr.

This course covers the following: 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).

020AIMES5 AI in Marketing 4 Cr.

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

020CONES3 Analog and Digital Communications 6 Cr.

This course covers the following: Narrowband signals; linear modulations: AM, Double Side Band, Single Side Band; frequency modulation: spectrum, modulator, demodulator, Phase Locked Loop; performance in the presence of noise; digital communication systems; Pulse Amplitude Modulation; QAM, PSK, ASK, MSK, GMSK modulations; coherent reception of linear modulations; baseband and narrowband models of a digital communication system; inter-symbol interference; eye diagram; Nyquist channel; performance of linear modulations over a Nyquist channel; reception in the 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 a switch. 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.

This course covers the following: IS (information systems) in companies. 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 - Merise 2 Extension.

020ANGES4 English 4 Cr.

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

435LALAL2 Arabic Language and Arts 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop essential language skills while exploring a range of cultural topics.
Specific objectives:
- Explore diverse forms of Arabic artistic expression.
- Understand the significance of art within Arab culture and identity.

435LALML2 Arabic Language and Media 2 Cr.

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop essential language skills while exploring a range of cultural topics.
Specific objectives:
- Understand the Arab media landscape and analyze its role in contemporary society.
- Develop critical media analysis skills in Arabic.

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

This course offers a gradual immersion into the Arabic language and culture, enabling students to develop essential language skills while exploring a range of cultural topics.
Specific objectives:
- Deepen knowledge of major Arabic literary and cinematic works.
- Develop critical analysis and debating skills in Arabic.

020IA2ES4 Artificial Intelligence 4 Cr.

This course aims to study artificial intelligence agents. It presents several methods of implementing these agents: from simple reflex agents to utility-based agents as well as learning agents. It first covers greedy search and A search*, the implementation of games through the Minimax and Expectimax algorithms, Markov Decision Processes (MDP) and Reinforcement Learning (RL). This course then introduces Machine Learning (ML) algorithms with some applications.
Prerequisite: Graph Theory and Operational Research (020TROES2).

020BLOES3 Blockchain and Cryptocurrency 4 Cr.

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

020ETHES3 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 wishing to work in public or private companies and in all fields. Its objective is to create awareness of the need for 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 them.

020DRAES5 Business Law 2 Cr.

This course provides an overview of the legal framework governing commercial activities and business entities. It covers fundamental concepts related to commercial transactions, the status of merchants, and the regulations governing business establishments.

020CLDES5 Cloud and Digital Transformation 4 Cr.

This course covers the following: A panorama of Cloud technologies and industry and its positioning in the IT landscape. The fundamentals of the Cloud and how it disrupts the way IT is purchased, consumed and operated. The definition of the Cloud, how that is different from traditional IT technically, economically, organizationally and in terms of business efficacy and innovation. The players and 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 the Cloud.

020TCOES2 Communication Skills 2 Cr.

This course highlights the importance of communication for engineering students. It explains that, in academic and professional activities, transmitting information is a powerful tool for convincing and influencing others. This course emphasizes that communication is unavoidable and involves errors and risks that may disturb or distort the reception of information. It provides students with essential basic rules of written, verbal, and non-verbal communication and raises awareness of errors to be avoided.

020PCOES4 Compiler Principles 4 Cr.

This course includes the following: 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.

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

020VIRES5 Computer Virology 4 Cr.

This course includes the following: 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 virus presence, Cohen's experiments on detectability and self-obfuscation – Self-reproducing Malware: script and macro-viruses, executable file virus, system virus and rootkit, Antivirus: Antivirus techniques, Antivirus Relay, Protection techniques, Antivirus Benchmarking and Testing – SPAM: Common techniques of SPAM and SPAM filtering.

020CVNES4 Computer Vision 4 Cr.

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

020IDCES5 Continuous Integration and Deployment 4 Cr.

This 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 allows practical application of concepts learned in class. By the end of this course, students will be well-prepared for careers in software development and IT operations.

020STGES5 Corporate Internship 2 Cr.

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

020CRYES4 Cryptography 4 Cr.

This course includes the following: Introduction to threats and attacks – services: authentication, integrity, confidentiality, non-repudiation – security mechanisms and techniques: 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.

This course covers the following: 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/output and network communications. Finally, it introduces students to the use of documentation, and application monitoring (profiling, logs, and traces) tools.

020ELNES2 Digital Electronics 6 Cr.

This course includes the following: Introduction to digital integrated circuit technology. Digital integrated circuits using MOS transistors, CMOS characteristics, fundamental building blocks, transistor-level design of CMOS logic gate 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.

This course covers the following: 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 covers 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 also 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 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.

This course explains how to write optimized and high-performance code using C++. It covers generic programming and templates to increase code efficiency, move semantics for performance optimization in memory-intensive applications, and the C++ Standard Library for efficient coding. The course also introduces build engines like CMake and Bazel to manage dependencies, automate builds, and implement software performance tests. Programming challenges allow students to apply optimization techniques in real-world scenarios. Students will develop skills to design reliable, high-performance software, preparing them for careers in game development, systems programming, embedded systems, and database applications.
Prerequisite: Object-Oriented Programming (020CPPES1).

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.

020SEMES3 Embedded Systems 4 Cr.

This course covers the following: 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 – FPGA: 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 hardware and software – NIOS II processor creation and programming.
Prerequisites: Digital Systems Design (020TEDCI4 or 020TEDNI4), Programming 1 (020IF1CI2 or 020IF1NI2).

020ENTES1 Entrepreneurship 2 Cr.

This course covers the following: 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.

This course includes the following: 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.

This course introduces 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 are illustrated by examples and exercises in Java, Python and Scala. Finally, the course concludes with an introduction to program proving using structural induction.
Prerequisite: Object-Oriented Programming (020CPPES1).

020GAIES5 Generative AI 4 Cr.

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

020TROES2 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.

This course delivers an introductory session on key concepts and risk analysis before covering IT security standards, best practices, and guidelines. It explains the ISO 27001-2 2022 standard, PCI DSS 4.0, OWASP, and SANS-CIS V8 top 18 cybersecurity controls. The course also covers security policy and procedures, human resources security, physical and logical security of systems and networks, incident management, and business continuity management.

020ATIES5 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 Data Center, 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 pitfalls, and a series of practical use cases that illustrate real life scenarios.

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.

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.

020EEIES4 Internet Ecosystem and Evolution 4 Cr.

This course covers the following: Internet governance – Autonomous system interconnection – Transit and peering agreements – Internet exchange points – Concepts of external routing – BGP routing protocol – BGP routing policies – Security of routing in the Internet – Utility and demand models – Pricing models in the Internet.
Prerequisite: Introduction to Data Networks (020INRES1).

020IDOES5 Internet of Things Technologies 4 Cr.

This course covers the following: 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 implementation 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/Wi-Fi 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 introduce 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.

This course includes the following: Introduction: data scientists work steps – numpy, pandas – data acquisition, data wrangling: data formats - pandasql, SQLite - API, data checking, data preparation, partial deletion, imputation

– exploratory data analysis: statistical significance tests, statistical rigor, t-tests, normal distribution, Welch's t-test, non-normal data, Shapiro-wilk test, Mann-Whitney U Test, non-parametric tests, machine learning, linear regression, gradient descent, coefficient of determination – data visualization: information visualization, components of effective visualization: visual cues, coordinate systems, scale and data types, context – visualization time series data, Plotting in Python – big data: basics of MapReduce: Hadoop – implementation: Jupyter Notebook.

020MLRES4 Machine Learning 4 Cr.

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

020MLOES5 Machine Learning Operations 4 Cr.

This course offers a comprehensive exploration of software engineering principles specifically adapted for artificial intelligence (AI) applications. It covers the full software development lifecycle (SDLC) of AI systems, including requirements engineering, design patterns for machine learning workflows, and software architecture for intelligent systems. Emphasis is placed on modern machine learning operations (MLOps) practices, such as automated training and deployment pipelines, model monitoring and performance evaluation, model versioning, and lifecycle management. The course also addresses responsible AI development, focusing on fairness, bias mitigation, and explainability, equipping students with the tools and methodologies needed to build robust, scalable, and ethical AI-powered software solutions.
Prerequisite: Machine learning (020MLRES4).

020MNGES5 Management 2 Cr.

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

020SMPES3 Microprocessor Systems 4 Cr.

This course covers the following: 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.

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

020MMDES4 Mining Massive Datasets 4 Cr.

This course includes the following: 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.

This course introduces 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.

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

020REMES4 Mobile Networks 4 Cr.

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

020PRMES4 Multidisciplinary Project 6 Cr.

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

020NLPES3 Natural Language Processing 4 Cr.

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

020IDRES5 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.

This course covers the following: 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).

020NQLES3 NoSQL Databases 4 Cr.

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

020MENES1 Numerical Methods 4 Cr.

This course includes the following: Introduction to numerical calculation, error analysis and propagation, numerical software, interpolation and approximation, integration and differentiation, numerical solution to differential equations, finite difference method, matrices, resolution of linear systems, matrix decomposition, eigenvalues and eigenvectors, non-linear system of equations.
Prerequisite: Differential Calculus (020CDFNI4 or Analysis 2 (020AN2CI3), Linear Algebra (020LALNI2) or Algebra 1 (020AL1CI2).

020CPPES1 Object-Oriented Programming 6 Cr.

This course introduces the fundamentals of programming in C and C++ with a focus on both procedural and object-oriented paradigms. Students will begin with C/C++ syntax, including typed variable declarations, basic input/output operations, expressions, and type conversions. Core control structures such as conditional branching, for and while loops, as well as function definitions, prototypes, parameter passing, and function overloading will be covered. The course then explores arrays, strings, pointer arithmetic, manual memory management, and cyclic dependency resolution, including deep copies and smart pointers. Students will gain a solid foundation in object-oriented programming, learning key concepts such as abstraction, encapsulation, inheritance, and polymorphism. Practical implementation includes defining classes, constructors, destructors, methods, attributes, static members, access modifiers, and operator overloading. The course also introduces modern software development practices using VS Code, compiling with CMake, and version control with Git and GitHub.
Prerequisite: Programming 2 (020IF2CI3 or 020IF2CI3).

020SSEES4 Operating Systems 4 Cr.

This course includes the following: 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.

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 (020EMENI3 or 020EMECI3).

020OAIES5 Optimization for AI 4 Cr.

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

020PPLES5 Parallel Programming 4 Cr.

This course covers the following: 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 them.
Prerequisite: Probability (020PRBNI4) or Analysis 3 (020AN3CI4).

020PCBES5 Printed Circuit Board Design Fundamentals 4 Cr.

This course introduces the fundamentals of designing Printed Circuit Boards (PCBs) using an 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 includes a project realization of a complex circuit using Proteus software.
Prerequisite: Digital Electronics (020ELNES2).

020GPRES2 Project Management 4 Cr.

This course explains how 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.

This course covers the following: 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.

This course provides a comprehensive introduction to database systems, emphasizing both theoretical foundations and practical applications. Topics include logical models of databases, relational algebra, and database design principles such as functional dependencies. Students will gain proficiency in Structured Query Language (SQL), covering both basic commands and advanced queries. Additional topics include views, triggers, functions, and stored procedures within database management systems. The course also explores indexing structures for physical database design. Students will develop skills to translate relational algebra into SQL and design efficient database solutions.

020RESES5 Secured Enterprise Networks 4 Cr.

This course covers the following: 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 the analysis 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), Probability (020PRBNI4) or Algebra 3 (020AL3CI4).

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 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 the need for Test Driven development using JUnit. It compares methods that can be used to estimate the cost of a software. It explains UI/UX to-do and not-do basics by studying the different cases of standalone, and web applications focusing on accessibility issues. Finally, it introduces DevOps principles and raises students' awareness about SAAS development and the value of IT automation.

020SQAES4 Software Quality Assurance 4 Cr.

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

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

This course covers the following: 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 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 of type Cubesat 1U using commercial components and boards.
Prerequisite: Analog Electronic (020ELAES1), Mechanics 1 (020MC1NI1 or 020MC1CI1).

020STAES1 Statistics 4 Cr.

This course provides a rigorous foundation in statistical inference, equipping students with the tools to make sound decisions based on data. It begins with a review of random variables and probability distributions, before distinguishing between descriptive and inferential statistics. Students will explore key concepts of sampling distributions and learn how to construct and interpret confidence intervals for means, variances, and proportions. The course then delves into parameter estimation techniques, including the method of moments and maximum likelihood estimation. In the latter half, emphasis is placed on the theory and application of statistical hypothesis testing for different types of parameters and distributions. Students will analyze real-world problems involving tests for means, variances, proportions, independence, and goodness-of-fit. The course concludes with an introduction to linear regression and non-parametric statistical tests.
Prerequisite: Probability (020PRBNI4) or Algebra 3 (020AL3CI4).

020ADUES3 Unix System Administration 4 Cr.

This course provides a comprehensive introduction to Unix and Linux operating systems, emphasizing practical skills and foundational concepts. Students will explore the Linux command-line interface, essential file system navigation, and disk management techniques. Key topics include text editing with tools like vi and nano, writing basic shell scripts for task automation, and performing core system administration tasks. The course also covers process and system monitoring, as well as essential networking and security principles. By the end of this course, students will be equipped with the skills needed to confidently operate and manage Unix/Linux environments in both academic and professional settings.

020VRTES4 Virtualization 4 Cr.

This course includes the following: 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.

This course covers the following: 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).

020WBPES3 Web Programming 4 Cr.

This course covers the development of web applications on both the frontend (client-side) and the backend (server-side). It is, in fact, a hands-on web programming course where a MongoDB, Express, React and Node (MERN) web application is gradually designed and implemented as the course progresses. The course first introduces the basic languages used for web development, namely HTML, CSS and JavaScript. They are followed by the

introduction of the Twitter Bootstrap web framework and the quick implementation of several web pages using this framework. Afterwards, the React framework along with its underlying Flux architecture are 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. The course then introduces Google Firebase which provides Backend as a Service (BaaS) functionalities to discharge the developer from implementing a backend. It concludes 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; Wi-Fi networks.

020WRNES1 Work Ready Now 2 Cr.

This course covers the following topics: Personal development - Communication skills - Job seeking skills - Work behaviors.