PREPARATORY CLASSES IN COMPUTER AND COMMUNICATIONS ENGINEERING

Main Language of Instruction:

French ○ English ☑ Arabic ○

Campus Where the Program Is Offered: *CST*

OBJECTIVES

The Computer and Communications Engineering Program aims to:

- Advance students in their careers across various sectors, spanning local, regional, and international levels, all while upholding ethical and professional standards.
- Facilitate a successful transition into world-class universities for higher education.
- Develop students into decision-makers, innovators, and industry leaders.

PROGRAM LEARNING OUTCOMES (COMPETENCIES)

- Identifying, formulating, and resolving complex engineering problems through the application of engineering, scientific, and mathematical principles.
- Applying engineering design methods to develop solutions that meet specified needs, considering public health, safety, welfare, and diverse global, cultural, social, environmental, and economic factors.
- Effectively communicating with diverse audiences.
- Recognizing ethical and professional responsibilities in engineering scenarios, making informed judgments that consider the impact of engineering solutions within global, economic, environmental, and societal contexts.
- Effectively collaborating within a team, contributing to leadership, fostering inclusivity, setting goals, planning tasks, and achieving objectives.
- Developing and conducting appropriate experiments, analyzing and interpreting data, and employing engineering judgment to draw conclusions.
- Acquiring and applying new knowledge as needed, employing appropriate learning strategies.

PROGRAM REQUIREMENTS

Required Courses (116 ECTS credits), Open Elective Courses (4 ECTS credits)

USJ General Education Program (4 ECTS credits) - 6 additional credits of Quantitative Techniques courses are counted in the Mathematics category

Humanities (4 Cr.)
Religious Studies (2 Cr.)
Religions in Their Diversity (2 Cr.)
Civic and Citizen Engagement (2 Cr.)
Engineering at the Service of the Community (2 Cr.)
Quantitative Techniques (6 credits counted in the Mathematics category)
Discrete Mathematics

Required Courses (112 ECTS Credits)
Mathematics (48 Cr.)
Analysis 1 (4 Cr.)
Analysis 2 (6 Cr.)
Bilinear Algebra and Geometry (6 Cr.)
Differential Calculus (6 Cr.)
Discrete Mathematics (6 Cr.)
General Analysis (6 Cr.)

Linear Algebra (8 Cr.)
Probability (4 Cr.)
Supplementary Mathematics (2 Cr.)

Sciences (36 Cr.)
Electromagnetism (4 Cr.)
General Chemistry (4 Cr.)
Magnetic Induction (2 Cr.)
Mechanics 1 (6 Cr.)
Mechanics 2 (4 Cr.)
Physical Signals (6 Cr.)
Physics Laboratory 1 (2 Cr.)
Physics Laboratory 2 (2 Cr.)
Thermodynamics 1 (4 Cr.)
Wave Optics (2 Cr.)

Programming (12 Cr.)
Programming 1 (4 Cr.)
Programming 2 (4 Cr.)
Programming 3 (4 Cr.)

Engineering Fundamentals (16 Cr.)
Digital Systems Design (6 Cr.)
Introduction to Engineering Projects (2 Cr.)
Linear Electrical Systems and Networks (6 Cr.)
MATLAB (2 Cr.)

Open Elective Courses (4 Cr.)

SUGGESTED STUDY PLAN

Semester 1

Code	Course Title	Credits
020DAMNI1	Discrete Mathematics	6
020ESCNI1	Engineering at the Service of the Community	2
020GANNI1	General Analysis	6
020GCHNI1	General Chemistry	4
020MH1NI1	Mechanics 1	6
020PHSNI1	Physical Signals	6
020SMTNI1	Supplemental Mathematics	2
	Total	**32**

Semester 2

Code	Course Title	Credits
020AY1NI2	Analysis 1	4
020LALNI2	Linear Algebra	8
020MINNI2	Magnetic Induction	2
020PL1NI2	Physics Laboratory 1	2
020PR1NI2	Programming 1	4
020TD1NI2	Thermodynamics 1	4
	Open Electives	2
	Total	**26**

Semester 3

Code	Course Title	Credits
020AY2NI3	Analysis 2	6
020BAGNI3	Bilinear Algebra and Geometry	6
020ECMNI3	Electromagnetism	4
020MH2NI3	Mechanics 2	4
020PL2NI3	Physics Laboratory 2	2
020PRONI3	Probability	4
020PR2NI3	Programming 2	4
020WOPNI3	Wave Optics	2
	Total	**32**

Semester 4

Code	Course Title	Credits
020DFCNI4	Differential Calculus	6
020DSDNI4	Digital Systems Design	6
020IEPNI4	Introduction to Engineering Projects	2
020LESNI4	Linear Electrical Systems and Networks	6
020MABNI4	MATLAB	2
020PR3NI4	Programming 3	4
018RDLDL1	Religions in Their Diversity	2
	Open electives	2
	Total	**30**

COURSE DESCRIPTIONS

020AY1NI2 Analysis 1 4 Cr.

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

020AY2NI3 Analysis 2 6 Cr.

This course aims to deepen the understanding of advanced concepts in mathematical analysis, covering 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 engineering applications. Finally, this course addresses Fourier series 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 (020AY1NI2)

020BAGNI3 Bilinear Algebra and Geometry 6 Cr.

This course aims to provide students with a solid understanding of fundamental concepts, including the reduction of endomorphisms, pre-Hilbert spaces, and endomorphisms of Euclidean spaces. Throughout this course, students will develop proficiency in techniques for reducing matrices and endomorphisms, along with their practical applications, such as calculating matrix powers, solving linear recurrent sequence systems, and utilizing linear recurrent sequences for matrix exponential. Additionally, this course examines pre-Hilbert spaces, emphasizing the inner product, orthogonality, and orthogonal projections. Students will learn to apply these concepts in solving problems related to orthonormalization. Furthermore, this course covers the study of planar isometries, encompassing translations, rotations and reflections, as well as isometries in space. Students will then acquire a strong foundation in bilinear algebra, and the necessary skills to apply these concepts effectively in practical situations.

Prerequisite: Linear Algebra (020LALNI2)

020DFCNI4 Differential Calculus 6 Cr.

This course offers an in-depth exploration of differential equations and systems of ODEs. It begins by thoroughly detailing fundamental concepts such as vector norms, subspaces, bases, and open and closed balls. Then, students will explore the notions of convergence and equivalence between norms. Additionally, this course covers topology by introducing fundamental concepts such as open and closed sets, adherent points, interior, and boundary points. A significant portion of this course is dedicated to the study of functions of several variables, exploring 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 covered in this course are essential for the development of advanced analytical skills and solving complex mathematical problems.

Prerequisite: General Analysis (020GANNI1)

020DSDNI4 Digital Systems Design 6 Cr.

This course aims to provide students with the opportunity to familiarize themselves with various methods for 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. This course covers essential concepts such as number systems and codes, combinational and sequential logic, logical functions, and integrated logic circuits. Additionally, students will 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.

020DAMNI1 Discrete Mathematics 6 Cr.

This course aims to provide students with a comprehensive understanding of propositional logic, mathematical reasoning, sets, relations, natural numbers, induction, applications, algebraic calculation, binomial coefficient and Pascal's triangle, polynomials, and integer arithmetic.

020ECMNI3 Electromagnetism 4 Cr.

This course begins with a distinct examination of stationary electric and magnetic fields, utilizing geometrical symmetries to leverage the properties of vector field flux and circulation. It introduces stationary local equations as a specialized application of Maxwell equations. Following the presentation of the Maxwell equations and the electromagnetic (EM) energy, the course shifts attention to the propagation of EM waves in vacuum.

Prerequisites: General Analysis (020GANNI1) - Physical Signals (020PHSNI1)

020ESCNI1 Engineering at the Service of the Community 2 Cr.

This course aims to explore the role of engineers in modern society, emphasizing 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 solutions.

020GANNI1 General Analysis 6 Cr.

This course covers the fundamental concepts of analysis, including limits, continuity, differentiation, sequences, sets of numbers, and differential equations. Its objective is to equip students with the necessary skills to effectively calculate limits, perform differentiation, and resolve linear differential equations of both first and second order. In addition, this course allows the development of mathematical reasoning skills. Students will learn how 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 advanced courses in mathematics, physics and engineering.

020GCHNI1 General Chemistry 4 Cr.

This course allows students to master acid-base balances, the preponderant reaction method, and the calculation of pH in the final state of chemical equilibrium, as well as pH-metric titrations. Additionally, it covers 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. Students will also learn about heterogeneous equilibrium in aqueous solutions, the effect of the common ion and complexation on solubility, complexation reactions, and the influence of pH on solubility. Finally, this course facilitates the analysis of potential-pH diagrams through examples along vertical and horizontal lines.

020IEPNI4 Introduction to Engineering Projects 2 Cr.

This course aims to help students develop a sense of responsibility, 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, facilitating the development of both conceptual and tangible components that actively contribute to the continuous process of knowledge creation, spanning from ideation to design and, in some cases, realization.

020LALNI2 Linear Algebra 8 Cr.

This course enables students to manipulate complex numbers, exploring their properties for calculations and equation-solving. Additionally, students will develop an understanding of geometric transformations such as translations, rotations and homothety. This course introduces vector spaces, helping students understand concepts such as linear independence, basis, and dimension. Linear transformations and matrices are central to the course, where students examine properties of linear transformations by learning 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. Moreover, students will master the computation of determinants, crucial in studying linear systems and their solutions. Acquiring these skills enables students to solve real-world problems and apply their knowledge in various fields such as science, engineering and computer science.

020LESNI4 Linear Electrical Systems and Networks 6 Cr.

This course aims to introduce the fundamental principles of electrical engineering, focusing on the analysis of electrical circuits. Students will delve into resistive network analysis, AC network analysis, transient analysis, and explore frequency response and system concepts. This course provides a comprehensive understanding of electrical circuits by extensively covering the use of Bode, Black, and Nyquist diagrams.

Prerequisite: Physical Signals (020PHSNI1)

020MINNI2 Magnetic Induction 2 Cr.

This course explores the fundamental principles of magnetic induction and its applications. It covers various topics such as magnetic fields, Faraday's law, electromagnetic induction, Lenz's law, transformers, etc. This 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.

020MABNI4 MATLAB 2 Cr.

This course covers various key aspects of MATLAB and Simulink, with a particular focus on symbolic computation in calculus and algebra, matrix calculations, programming, and an introduction to Simulink. Students will delve into the advanced features of MATLAB, with an emphasis on its application across different engineering fields. Symbolic calculus and algebra will enable students to manipulate complex mathematical expressions, simplify equations, compute derivatives and integrals, and solve systems of symbolic equations. Additionally, students will learn to manipulate matrices and vectors, and perform essential matrix operations. This course also covers practical aspects of MATLAB programming, teaching students how to write custom scripts and functions. Furthermore, it introduces 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 (020GANNI1) - Programming 1 (020PR1NI2)

020MH1NI1 Mechanics 1 6 Cr.

Particle mechanics, a branch of physics, studies the motion of objects by considering them as dimensionless mass points. It simplifies the study of physical systems by neglecting objects' dimensions and internal structure, focusing solely on their overall motion. In this case, the object in question is assumed to be point-like, without significant spatial dimensions, simplifying calculations by only considering mass and position in space. The fundamental principles of particle mechanics are based on Newton's laws, which describe the relationship between applied force, mass, and motion. Applying these principles enables students to analyze particle motion by studying the applied forces, mass, and initial conditions. Particle mechanics provides an essential foundation for understanding advanced classical mechanics concepts, such as kinematics, dynamics, laws of motion, energy, etc.

020MH2NI3 Mechanics 2 4 Cr.

Solid mechanics, a branch of mechanics, studies the motion and equilibrium of objects considered as rigid bodies. A rigid body is an object in which different parts do not deform relative to each other when subjected to external forces. This course covers the laws of mechanics for solid systems. Students will be able to apply various methods to determine the center of mass of a solid and study its translational and/or rotational motion around a fixed axis. With comprehensive understanding of the force system in mechanics, and their derived laws, students will acquire proficiency in applying static, dynamic, and energetic laws to solve complex mechanical problems.

Prerequisite: Mechanics 1 (020MH1NI1)

020PHSNI1 Physical Signals 6 Cr.

This course primarily aims to assist students in developing a comprehensive grasp of the core principles related to linear circuits and signal propagation. Throughout this 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 acquire the essential knowledge and skills to effectively analyze and resolve challenges within these domains.

020PL1NI2 Physics Laboratory 1 2 Cr.

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

020PL2NI3 Physics Laboratory 2 2 Cr.

This course aims to solidify students' theoretical knowledge by putting it into practice through a variety of topics. Students will explore areas such as electrical circuits, linear filters, Fourier analysis, frequency analysis, the Thomson tube, thermal conduction, the Stefan-Boltzmann law, the pulsograph (oscillator with two degrees of freedom), diffraction and interference, as well as polarization.

Prerequisite: Physics Laboratory 1 (020PL1NI2)

020PRONI3 Probability 4 Cr.

This course aims to provide students with a solid understanding of the probability theory and equip them with the necessary skills to effectively calculate probabilities. Throughout this course, students will be introduced to various aspects of probability, beginning with combinatorics. They will learn techniques such as combinations, permutations and arrangements. Furthermore, they will explore concepts that enhance the understanding and manipulation of probabilities on a countable set, including the monotone convergence theorem, Boole's inequality, conditioning, compound probabilities, total probabilities and Bayes' formula. Additionally, the course will emphasize the study of discrete random variables, enabling students to model and analyze random phenomena 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 (020AY1NI2)

020PR1NI2 Programming 1 4 Cr.

This course covers the hardware components of a computer and introduces the basic concepts of high-level programming using Python. Topics covered 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, and functions from external modules.

020PR2NI3 Programming 2 4 Cr.

This course aims to enable 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 (020PR1NI2)

020PR3NI4 Programming 3 4 Cr.

This course covers advanced programming concepts in Python. It includes a systematic study of existing sorting algorithms and their time complexity calculations. This course explores the application of recursion to sorting algorithms with a recursive structure. Additionally, it 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 (020PR1NI2)

018RDLDL1 Religions in Their Diversity 2 Cr.

This course offers an in-depth exploration of three monotheistic religions: Judaism, Christianity, and Islam. It analyzes the historical context, cultural influences, and geographical factors that have contributed to the formation and expansion of each religion.

020SMTNI1 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, the numerical sequences, the circular functions, as well as definite and indefinite integrals. By studying composite and inverse functions, students will understand 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 is the study of basic trigonometric functions: sine, cosine and tangent. Finally, this course covers definite and indefinite integrals by exploring their properties, the technique of integration by parts, the substitution method, and a fundamental application: area calculation.

020TD1NI2 Thermodynamics 1 4 Cr.

This course allows students to master the key concepts of thermodynamics. It begins with an introduction to the different states of matter and different scales of study. Moving forward, it explores the state of a thermodynamic system, equations of state, and internal energy. Students will then explore transformations of a thermodynamic system and the first law of thermodynamics, with a focus on pressure forces and heat transfers. Additionally, the course introduces the second law of thermodynamics and the concept of entropy, along with their applications. It also covers the thermodynamic study of phase transitions.

020WOPNI3 Wave Optics 2 Cr.

This course covers the key concepts of the wave theory of light. It begins with defining 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). Additionally, this course examines the impact of extended and narrow-spectrum light sources.

Prerequisite: Physical Signals (020PHSNI1)