INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

SECOND YEAR INSA TOULOUSE

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Mathematics

Introducing

Description

In the Analysis-Algebra course:
- Laplace transform and application to the resolution of first and second order linear ODEs.
- bilinear algebra: bilinear forms, symmetric bilinear forms, associated quadratic form, scalar product, orthogonality, Gram-Schmidt orthogonalization procedure, orthogonal of a vector subspace, orthogonal projection, norm associated with a scalar product, convergence, continuity, Weierstrass theorem.
- functions of several variables: continuity, partial derivatives, differentiability, local extremum points, multiple integrals.

In the Probabilities section:
- probability space and conditional probabilities, independence of events
- discrete and continuous random variables (law of probability, expectation, variance, etc.)
- couples of random variables
- limit theorems (law of large numbers, central limit theorem)

Objectives

Introduce the Laplace transform and its use to solve certain ordinary differential equations.
Introduce some notions of bilinear algebra, in particular the scalar product and orthogonality.
Introduce concepts of analysis in several variables.
Introduce the basic concepts of probability.

Necessary prerequisites

1st year linear algebra.
1st year analysis: functions of a single variable (continuity, derivative, integrals, local extremum points).
Newton binomial, geometric series, exponential series.

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Practical info

Location(s)

Toulouse

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Transfer bases

Introducing

Description

Transport phenomena: Continuum media, concept of shear stress. Statics of fluids. Kinematics of fluids.
Principles of conservation of mass, momentum and energy. Writing local equations and the global balances of mass, momentum and energy. Rheological laws (examples of Newtonian fluid and some non-Newtonian fluids).
Boundary conditions.
Exact solutions of some model problems. Analogies of transfers (Newton, Fourier, Fick).

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
- The basics of continuum mechanics
- The concept of balance and the different scales of application
The student will be able to:
- Define a system and its contours, and calculate inlet, outlet and transformation fluxes
- Write local and macroscopic balances of mass, energy and momentum
- Solve analytically simple problems of Newtonian fluid mechanics

Necessary prerequisites

UF "Thermodynamics - Basics and Applications" from the first year of INSA or equivalent.
First-year mathematics (differential and integral calculus, notions of geometry, trigonometry and algebra).

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Organic chemistry

Introducing

Description

Part I: Spatial and electronic structures.
- Hybridization of atomic orbitals and geometry of organic molecules.
- Nomenclature.
- Constitutional and conformational isomerism.
- Stereochemistry (enantiomerism, diastereosisomerism).
- Electronic effects: polarity, polarizability, inductive and mesomeric effects.
- Structure-reactivity relationship: the main classes of reagents: acids, bases, nucleophiles, electrophiles, reaction intermediates: carbocations, carbanions, free radicals.

Part Two: Reactivity of compounds. The main reaction mechanisms.

- Radical substitutions on alkanes (SR).
- Electrophilic additions to alkenes (AE).
- Electrophilic substitutions on arenes (SE).
- Nucleophilic substitutions in aliphatic series (SN1 and SN2).
- Elimination reactions (E1 and E2).

Basic practical work:
- Doubling of a racemic mixture.
- Chemical synthesis.
Acquire and implement the main experimental techniques (distillation, extraction, reflux set-up, recrystallisation, TLC and silica gel column chromatography).
- Raise students' awareness of safety during chemical manipulations.

UV visible spectrophotometry: principles, theory, Beer Lambert's Law.
IR and NMR spectroscopy: principles, equipment, interpretation of spectra.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):

- the spatial and electronic structures of molecules in order to understand the main reaction mechanisms and their stereochemical consequences.

- the basic reaction mechanisms of chemical reactions in the living world and industrial organic chemistry.

The student should be able to:

- Identify the main chemical functions and name chemical compounds.
- Represent chemical compounds (Newman, Fischer, Cram).
- Distinguish between the different types of isomerism: conformational and configurational isomerism (enantiomerism, diastereoisomerism).
- Analyse electronic effects (inductive effects and mesomeric effects) in a molecule.
- Describe the different classes of reagents and reaction intermediates.
- Describe the main reaction mechanisms encountered in chemistry: Radical substitutions on alkanes (SR), Electrophilic additions on alkenes (AE), Electrophilic substitutions on arenes (SE), Nucleophilic substitutions in aliphatic series (SN1 and SN2), Elimination reactions (E1 and E2).
- Carry out organic syntheses using the basic experimental techniques of organic chemistry.
- Use the various techniques for characterising organic compounds (UV, IR, NMR)

- Interpret UV, IR and NMR spectra

Necessary prerequisites

I1ANETCH Atomistic
I1ANETCH Solution chemistry

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Practical info

Location(s)

Toulouse

Thermodynamics of physical-chemical systems

Introducing

Description

Systems, quantities and properties of states
Energy description of systems
Macroscopic properties of pure components
Description of physicochemical systems
Reaction quantities
Chemical potential and fugacity
Real solutions
Characterization of phase equilibria
Chemical equilibrium

Objectives

At the end of this module, the student will have acquired systematic practice in the implementation of material and energy balances with chemical reactions, and analyzes in closed and open energy systems. He will understand the behavior of real fluids, the generalized formulation of these behaviors using equations of state, their behavior in saturation zones, the main associated thermodynamic diagrams and their application to various systems.

He will have acquired the basics of thermochemistry including reaction quantities as well as the influence of temperature on these quantities (Kirschhoff), the heat of reaction, and will apply this knowledge to reactive systems under various conditions both theoretically through supervised work and practically in TP.

He will also have acquired the bases for the description of physicochemical systems and solutions (ideal/non-ideal) allowing the characterization and calculations of equilibrium between phases in the solutions. These bases are necessary for understanding and sizing unit operations in chemical and biochemical systems.

He will understand and apply the concepts associated with chemical equilibria: limitation of reaction progress, stability, instability and spontaneity of chemical reactions, chemical equilibrium constant, displacement of the equilibrium (Lechatelier's law).

He will apply this knowledge to homogeneous equilibria in the gas phase and in the condensed phase as well as to heterogeneous chemical equilibria.

Necessary prerequisites

UF « Thermodynamique Bases et applications » (code I1ANTH11) de la première année de l'INSA ou équivalent.

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Practical info

Location(s)

Toulouse

Structural Biochemistry

Introducing

Description

Detailed description of the structure of the molecules listed below and their major role in the cellular functioning of living beings:
- Monosaccharides, oligosaccharides, and polysaccharides
- Fatty acids and lipids
- Nucleotides and nucleic acids (DNA and RNA)
- Amino acids and proteins

Description and implementation of several analytical methods to elucidate the structure of certain compounds.
Introduction to the study and use of these biomolecules for biotechnologies in the context of ecological transition, sustainable development, and the bioeconomy.

Objectives

By the end of this module, students should have understood and been able to describe the overall structure of the four major classes of biomolecules that make up living systems (carbohydrates, lipids, nucleic acids, and proteins), as well as their function in cells. Students will also be aware of the great diversity that exists in the living world and its importance. They will also be able to cite certain techniques for analyzing these molecules and should be familiar with some simple examples of their relevance to biotechnology.

Necessary prerequisites

I1ANBC11 Chemistry
I2BECH11 Organic chemistry

Évaluation

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Practical info

Location(s)

Toulouse

Expression

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

None

Évaluation

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Practical info

Location(s)

Toulouse

Foreign Language 1

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional path initiative

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

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Practical info

Location(s)

Toulouse

Analytical Methods 1

Introducing

Description

This module is divided into three parts in order to understand and manage theoretical and experimental concepts relating to analytical methods.

Electrochemistry (Conductimetry, probes, ion-selective electrodes).

Liquid and gas Chromatographies: theory, instrumentation and quantification methods.

Sensors (biomass, microscopy, temperature, flow, pressure, viscosity, etc.).

Objectives

At the end of this module, the student will have understood and be able to explain the principles of analytical techniques implemented currently in laboratories and the associated mechanisms using his/her knowledge in quantum physics and chemistry (chemical reactions, physical and chemical properties ¿)

The student will be able to:

AA1 Choose the most relevant technique regarding the problem by explaining the relating theoretical concepts.

AA2 Carry out these analytical techniques.

AA3 Define and interface sensors with their electronic signal processing unit and identify needs for filtering, amplification and other signal processing requirements

AA4 Analyse and discuss the results in a critical way.

Necessary prerequisites

Thermodynamic 1Y (I1ANETTH) and 2Y (I2BETH11) / Chemistry of solutions 1Y (I1ANETCH) / Organic Chemistry 2Y (I2BECH11) / biostructural chemistry 2Y / Electrokinetics 1Y

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Chemical reaction engineering

Introducing

Description

Mass balance in reactional homogeneous systems. Continuous and batch systems. Transient and steady states. Progress reaction parameters and global balances. Reaction rate, law for reaction rates and temperature influence. Identification of reaction rate laws. Pseudo-first order approximation. Ideal reactors (batch, continuous stirred and plug flow). Mass balances application in ideal reactors. Isothermal reactors design.

Objectives

At the end of this module, the student will know and be able to explain (main concepts):

- kinetics of a chemical, or biochemical reaction
- Rate-limiting step, catalysis, inhibition
- Reaction rates, kinetic order and constant, activation energy
- Reaction progress parameters
- Mass balances applied to reactors
- Continuous and batch stirred reactors
- Plug flow reactors

The student will be able to:

- define a system, its boundaries, for a defined purpose; calculate all the molar fluxes (inlet, outlet, transformation, variation);
- choose the best ideal reactor for a homogeneous isothermal chemical reaction in liquid phase and calculate it (reactor design)
- write mass balances by using reaction progress parameters
- establish a kinetic law from reaction mechanisms in the case of simple chemical and enzymatic reactions. Understand how physiological aspects can impact the kinetics of microbiological reactions.
- propose experimental and numerical methods for determining the kinetic law for a homogeneous reaction from experimental data.
- determine a kinetic constant for a given temperature (Arrhenius law)
- treat a general homogeneous isothermal problem of chemical reaction engineering

Évaluation

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Practical info

Location(s)

Toulouse

Process control

Introducing

Description

- Overall total or partial mass balance, enthalpy balance in transient and steady state
- Concept of system, input and output variables, disturbance
- Some mathematical aspects: linearization of a function with several variables, Laplace Transformation
- Transfer function
- Block diagram
¿ 1st order, 2nd order and pure delay linear systems
- Open loop and closed loop
- Derivative Proportional Integral Regulation
- Concept of stability of a system
- Setting the parameters of a regulator
- Applications: chemical and biological reactors

Objectives

Acquire the main concepts of process control and apply them to simple cases of process engineering and biochemical engineering.

Necessary prerequisites

I2BEBT10 Global mass and energy balances on geometric domains
I2BEMT11 Laplace transform, Taylor expansion, Decomposition into simple elements

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Industrial facilities

Introducing

Description

-Introduction of general concepts associated with a process, including classification and schematization and the notion of unit operation.
- Presentation of the methodology for carrying out (macroscopic) mass balances on a process in stationary mode including the notion of variance
- Application of these concepts on case studies of increasing complexity
- Mass balances on different unit operations (separator, mixer, divider, etc.) and on processes combining these unit operations, reactors, etc. –
-Mass balances on installations with or without recycling

Objectives

The mass balance is an essential tool for quantifying the performance of industrial installations and optimizing them according to criteria of yield, production, productivity, etc. It is also an essential tool for the environmental assessment of processes and bioprocesses. This course therefore aims to train students in the functional analysis approach of processes by introducing the basic concepts associated with the study of processes, including their schematization and the writing of the corresponding macroscopic mass balances. It presents a methodology for solving these balances through the concept of the degree of freedom of a system (variance). These approaches are illustrated through case studies ranging from a unit operation to a complex process operating in steady state.
At the end of the course, the student will be able to:
- Understand the basic concepts associated with processes (continuous process, discontinuous process, reactions, separations, recycling) –
-Understand and analyze a process from the diagram and literal descriptive elements in order to identify the mass flows (flow rates and compositions)
- Calculate the variance of a system and a process
- Write and solve the mass balances associated with an industrial installation operating in steady state
- Present these results by checking their consistency (physical meaning, units..)

Necessary prerequisites

none

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Careers

Introducing

Description

The number of hours devoted to “discovering careers” is approximately 50 hours. It encompasses all the activities listed below and scheduled in the timetable.

Project to discover engineering professions and functions
This project is carried out in groups of 5 or 6, and aims to expose students to the realities of the industrial world as early as possible. To this end, they are asked to carry out a study designed to identify the jobs available to them - R&D engineer, quality engineer, production engineer, technical sales engineer, etc. - and the sectors in which they will be able to work - environment, pharmaceuticals, chemicals, agri-food, etc. Ideally, all these projects should cover the full range of opportunities offered by the 2 Biochemical Engineering and Process Engineering specializations.

Please note that these projects are not bibliographic projects designed to explain how a particular product is made! The aim is to place each industrial branch - which can, if necessary, be described in scientific and technological terms - in its organizational, economic, environmental and/or societal context, and above all to identify the specific features, in terms of the job, of the engineers working in it. Students are guided in their work by a teacher, but it is essential that during these projects students get out of INSA, meet professionals, visit factories, firms, design offices…

Objectives

The “discovering careers” section complements the “PPI” scheme, which helps students to reflect on and discuss their educational and career plans, and to take a more coherent career path. The objectives of “discovering careers” are listed below (in no particular order):
1°) to help students project themselves into what will be their daily professional life when they leave INSA, and to enable them to make their choice of specialization in year 3 in a well-thought-out manner. The aim is to give them as complete a picture as possible of the career opportunities available at the end of the 2 specializations to which the pre-orientation leads;
2°) to encourage students to open up to the world outside INSA, with particular emphasis on contacts with industry;
3°) to enable students to understand the usefulness of the courses they are taking by placing them in a professional context;
4°) to give students who have a particular project the opportunity to implement it (civic or community project, etc.)

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Practical info

Location(s)

Toulouse

Numerical calculation and statistics

Introducing

Description

Numerical calculation:
- concept of loop, tracing of functions
- calculation of an integral by a numerical method (trapezoid, midpoint) writing of a generic solver.
- resolution of nonlinear equation systems: Newton's method.
- resolution of differential equations: explicit and implicit Euler method
- resolution of a system of differential equations: use of an EDO solver

Statistics
- one- and two-dimensional descriptive statistics
- principal component analysis
- the point estimate and by confidence intervals of the mean and variance in the Gaussian and non-Gaussian case
- tests on the mean, homogeneity and normality
- the principles of linear models and generalized linear models.

Objectives

Give students basic programming training
Learn numerical methods to solve the different classes of equations typical of their future field of specialty (Chemical and Biological Engineering)

Necessary prerequisites

Elementary notion of mathematical analysis: Matrix, vectors, scalar product
Basic notions of programming: loop, test, assignment, writing functions

Évaluation

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Practical info

Location(s)

Toulouse

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

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Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

Évaluation

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Practical info

Location(s)

Toulouse

Microbiology

Introducing

Description

Microbiology :
- Cell biology of microorganisms: General aspects of the microbial world, Prokaryotes: structure and function, Eukaryotes: structure and function, Nutrition and growth, Viruses.
- Classification: Principles of classification, Identification methods, Overview of the microbial world.
- Industrial applications: Industrial microbiology, Water treatment and microorganisms, Negative implications of microorganisms.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):

Structure of prokaryotes and eukaryotes. Reproduction. Nutrition. Notion of metabolism. Growth and counting. Classification, identification and industrial applications of microorganisms.

The student should be able to:
Describe microbial diversity and its role in natural cycles. Present the structures and functions of cellular components. Grow and count microorganisms. Master the investigative methods used to classify and characterise organisms. Describe the products of industrial microbiology and water treatment techniques.

Necessary prerequisites

I2BEBS10 Structural biochemistry of carbohydrates, lipids and proteins.

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Elective scientific course

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Physical Activities and Sports

Introducing

Description

Évaluation

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Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Mathematics

Introducing

Description

Part: Mathematical Concepts (Lectures = 17.5h / Tutorials = 17.5h)
1.Generalized integrals and series (2 Lectures / 2 Tutorials)
2.Norms 1, 2, and infinity in finite and infinite dimensions (1.5 Lectures / 1 Tutorial)
3..Scalar product, Cauchy-Schwarz inequality, and Pythagoras (1.5 Lectures / 1 Tutorial)
4.Vector orthogonality, decomposition on orthogonal bases (1 Lecture / 2 Tutorials)
5.Special matrices: symmetric, projection, and isometries (1.5 Lectures / 2 Tutorials)
6.Continuity and differentiability of multivariable functions (2 Lectures / 3 Tutorials)
7.Multiple integration (3 Lectures / 3 Tutorials)
8.Hessian matrix and optimization (1.5 Lectures / 0 Tutorials)

Part: Numerical Analysis (Lectures = 7.5h / Tutorials = 7.5h / Lab Work = 17.5h)
0.Introduction to Python and numerical analysis (1 Lab Session)
1.Numerical integration (Rectangle, trapezoid, and Simpson methods) (1 Lecture / 1 Tutorial / 1 Lab Session)
2.Norms and conditioning (Induced norms and the impact of conditioning) (1 Lecture / 1 Tutorial / 1 Lab Session)
3.Direct resolution of linear systems (Gaussian elimination and LU decomposition) (1 Lecture / 1 Tutorial / 1 Lab Session)
4.Solving nonlinear equations (Bisection, Newton's method, and fixed-point iteration) (1 Lecture / 1 Tutorial / 1 Lab Session)
5.Polynomial interpolation (Vandermonde matrices and the Runge phenomenon) (1 Lecture / 1 Tutorial / 1 Lab Session)
6.Least squares method (Normal equations) (1 Lecture / 1 Tutorial / 1 Lab Session)

Part: Probability and Statistics (Lectures = 13.75h / Tutorials = 13.75h / Lab Work = 2.5h)
1.Events, probabilities, conditioning, independence
2.Random variables, probability distributions, discrete variables
3.Continuous random variables, random vectors
4.Statistical inference: point estimation, confidence intervals, and hypothesis testing

Objectives

This Teaching Unit (UE) aims to master the essential concepts and foundational knowledge in mathematics for engineers in Civil Engineering or Mechanical Engineering. The UE is divided into three components with complementary objectives:
1.Mathematical Concepts: Master essential mathematical tools for Civil or Mechanical Engineering.
2.Numerical Analysis: Implement efficient algorithms using Python and analyze their convergence.
3.Probability and Statistics: Understand and apply probabilistic and statistical modeling.

Necessary prerequisites

First-year Mathematics course. Note that the different sections are not independent, and tools introduced in one part may be used in others.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Mechanics

Introducing

Description

Analyze structure equilibrium and apply Newton's second law to a system of rigid bodies:
- Model usual mechanical actions as wrenches using screw theory (kinematic joints and external forces)
- Model friction using Coulomb's Law of Friction
- Model the tilting of a plane joint using a mobile point of application for the normal force
- Identify a statically determinate/indeterminate system (number of static unknowns)
- Determine a solving strategy for the second law (systems of interest, external forces, free body diagram, equations to use, solid bodies subjected to only two external forces)
- Calculate the mechanical actions that need to be determined (joints or actuators)
- Validate the stability of a structure (sliding, tilting on a plane, loss of contact)

Determine the absolute or relative velocity and acceleration of a point on a rigid body:
- Interpret the kinematic parameterization of a mechanism
- Describe the velocity vector field that characterizes a body's motion as a twist using screw theory
- Apply velocity addition, velocity field analysis and time derivatives of vectors in rotating frames
- Determine the condition for rolling without slipping at the contact between two bodies
- Solve a 2D kinematics problem graphically (instantaneous axis of rotation, velocity field)

Objectives

Solid mechanics
At the end of this course, you will be able to:
- determine the mechanical loads exerted on rigid bodies (preliminary step to sizing),
- verify the stability conditions of a mechanism (friction, tilting, loss of contact),
- analyze velocities and accelerations in a mechanism (particularly in power transmissions).

Necessary prerequisites

- Reading a kinematic diagram
- Solving systems of algebraic equations
- Trigonometry and projections
- Vectors, scalar and vector products
- Derivatives of composite functions

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Design – CAD

Introducing

Description

3 ECTS: Mechanical Design

Design and understand the architecture of mechanisms.

3 ECTS: Civil Engineering BIM

Model and transition from 2D to 3D.
Apply concepts of construction techniques.

Objectives

The student must be able to:

Define a simple rotational guide.
Specify the assembly of components.
Represent schematically (modeling).
Provide a graphical representation of a mechanism's architecture.
Create 2D and 3D graphical representations.
Model elements of civil engineering projects.
Query a digital model to extract production data.
Understand the mechanical functioning of civil engineering projects.

Necessary prerequisites

Introductory courses on industrial techniques in the first year: I1ANTI11 and I1ANSY21.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Strength of Materials 1

Introducing

Description

Modeling with beam-like structures ;
Internal forces (cohesion forces), Relation between continuum stresses and internal forces, Equilibrium equations (in terms of internal forces) ;
Computing strains, stresses and displacements for the elementary loading cases : axial, bending and torsion.

Objectives

Strength of materials: Introduction to beam theory
- Drawing internal forces diagrams for an isostatic, straight, planar beams.
- Calculate the beam strains and stresses for a few simple loads in the case of a simple section and a slender beam.
- Final objective is to learn how to analyse and design beam-like structural members or machine elements subjected to tension, compression, torsion, and bending.

Necessary prerequisites

Equilibrium equations in terms of forces and moments.
Differential and integral calculus.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Expression

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

None

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

Foreign Language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional path initiative

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Ordinary Differential Equations and Series

Introducing

Description

1.Review and Additions on First- and Second-Order Scalar ODEs: Linear cases, Equations of Mechanics, Riccati Equations.
2.Qualitative Aspects of ODEs: Maximal and global solutions, Existence and Uniqueness Theorems, Equations with separable variables, Phase portraits.
3.Numerical Aspects of ODEs: Euler schemes, Trapezoidal method, Runge-Kutta schemes, Error estimation.
4.Function Series: Review of function sequences and numerical series, Modes of convergence and summation properties, Power series applications to ODEs.
5.Linear Differential Systems: First-order systems with constant coefficients, Matrix exponential, Practical resolution, Phase portraits in the plane, Stability of equilibria.
6.Laplace Transform: Integral definition, Computational properties, Applications to ODEs.

Objectives

This module introduces the mathematical framework of Ordinary Differential Equations (ODEs) and provides methods for qualitative and quantitative analysis. Students are expected to identify the type of an ODE and apply appropriate techniques to solve or characterize its solutions.

Necessary prerequisites

Mathematics courses from the first year and UE I2ICMT31.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Dynamics

Introducing

Description

- Analyze the spatial mass distribution of a rigid body (inertia matrix, center of mass).

Newton's first law of motion for a system of rigid bodies:
- Determine the linear and angular momentum and their time derivatives using screw theory
- Determine a solving strategy to apply the first law (systems of interest, equations to be used)
- Determine mechanical actions or differential equations of motion by applying the first law

Work-energy theorem for a system of rigid bodies:
- Calculate the kinetic energy of a body in motion (rotation, translation, helical motion)
- Determine the power of external forces and contact forces
- Derive an equation of motion or determine a force using the work-energy theorem (WET)

Objectives

Rigid body dynamics
At the end of this course, you will be able to:
- Determine the motion of a mechanism over time given the forces acting on it,
- Determine the mechanical actions in the joints or actuators required to produce the desired motion.
Newton's first law of motion and the work-energy theorem (WET) will be used

Necessary prerequisites

Solid mechanics I course:
- Force and moment calculation
- Common forces modeling
- Calculation of velocity and acceleration
- Screw theory: modeling forces as wrenches and velocity fields as twists
- Solving a statics problem

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Elective scientific course

Introducing

Description

Students take one of the following courses, of their choice:
- spatial data acquisition,
- mechanics for health,
- Python for engineers,
- networks and electrical machines.

Objectives

Elective courses are scientific courses related to the content of the pre-orientation, i.e. courses that can be used by future engineers in the Civil Engineering and Mechanical Engineering sectors. These courses are not prerequisites for the rest of the curriculum.

Necessary prerequisites

See detailed descriptions of each course.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Strength of Materials II

Introducing

Description

Beam theory:
• Transition from the real system to the beam type model: average line and geometric properties of sections, connections, loading, linear elastic material;
• Static reminders – Balance – Linking actions – Isostaticity and hyperstaticity;
• Internal forces: normal force, bending, shear force, torsion;
• Stress/strain/displacement fields and potential energy of elastic deformation associated with the different internal forces;
• Methods for solving hyperstatic structures (by application of the superposition principle and Castigliano's theorem).

Objectives

The student will be able to assess:
The mechanical behavior of isostatic and hyperstatic "beam" type structures under static loading:
- Model a "beam" type structure (geometric characteristics, support and loading),
- Calculate the support actions and internal forces,
- Calculate the stress, deformation and displacement fields associated with each type of internal force,
- Calculate the potential energy of elastic deformation,
- Apply resolution methods for hyperstatic structure of degree 1.

Necessary prerequisites

Mechanics
Materials science
Mathematical tools

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Materials science

Introducing

Description

Detailed programme for common materials:

6 CMs of 1.25h each
Crystallography of metals and ceramics - Amorphous structures
Thermodynamics of binary metal alloys: Gibbs free energy - Entropy - Enthalpy Binary iron-carbon metal alloy: Phase equilibrium diagram - Eutectoid transformation
Mechanical behaviour of construction materials at room temperature: Elasticity - Plasticity - Ductility - Fragility
Mechanical properties of materials in use and mechanical tests at room temperature
Physical properties of construction materials and associated non-destructive testing
Chemical properties of construction materials and corrosion phenomena

Tutorial topics: 4 tutorials of 1.25 hours each
1/ Crystallography: Pattern - Atomic density - Miller indices
2/ Phase diagram: Iron-carbon diagram - Determination of the microstructure of a steel at room temperature
3/ Mechanical properties: Tensile strength curve and skimming - Strain energy
4/ Chemical properties: Corrosion

Practical work session: 2 TPs of 3 hours each
TP1 Mechanical tests: tensile test - Hardness test - Impact test
TP2 Chemical tests

Objectives

Make the link between the mechanical, physical and chemical properties of construction materials (metals, ceramics and polymers) and the characteristics of these materials on an atomic (crystallographic) and microstructural (binary phase diagram) scale.

Necessary prerequisites

For the common core of materials: Notion of Crystallography and Thermodynamics from 1A

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Building Environment and Materials

Introducing

Description

Materials for Civil Engineering: 18.75 hours

11.25 hours: Lectures on the portfolio of construction materials used in Civil Engineering.
2.5 hours: Tutorials on Life Cycle Assessment (LCA) approaches and quantitative methods.
5 hours: Laboratory sessions on materials and digital tools.

Project Design Component: 52 hours

7.5 hours: Lectures on design principles (Architecture and Structure).
8.75 hours: Tutorials on architectural analysis, load paths, and structural design linked to construction techniques.
2 hours: Construction site visit.
33.75 hours: Small-group project work, focusing on project selection and approach, architectural and structural design, justification of choices, numerical modeling, quantification, technical design details, defining and calculating load transfers, and assessing the environmental impact of construction materials.

Objectives

The student must be able to:

Understand and develop materials used in Civil Engineering.
Develop an interdisciplinary understanding of sustainable urban development.
Navigate the complexity of civil engineering design projects and apply multicriteria, multi-stakeholder, and multi-scale spatial and temporal decision-making frameworks.
Explore the concepts of eco-design.
Manage the design of architectural programs.
Define, select, and specify construction materials.
Justify and assess the environmental impact of prescribed solutions.
Design the load-bearing structure of buildings (limited to vertical loads).
Calculate and predict load transfers (restricted to gravitational and operational loads).

This course is designed to:

Facilitate the development of skills in civil engineering project methods.
Promote the use of digital tools.
Enhance practices in design projects.
Introduce architectural design principles.
Provide guidance on the selection of construction techniques and materials.
Develop quantitative and multicriteria approaches.

The module aims to:

Present the dual Architect-Engineer curriculum.
Foster analytical thinking and design methodologies for building projects integrated within an urban fabric.
Serve as a practical application of concepts from Strength of Materials 2 (covered in semester 4), specifically focusing on the understanding of beams, loads, and the concrete application of static principles.

Necessary prerequisites

"Civil Engineering Design with BIM: Utilizing a 3D

modeling tool, focusing on the technical approach to parametric families and objects, and emphasizing collaborative workflows.
Strength of Materials 1 (SOM 1): Ability to apply the Fundamental Principle of Statics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Design and Materials Project

Introducing

Description

Detailed programme for common materials:

6 CMs of 1.25h each
Crystallography of metals and ceramics - Amorphous structures
Thermodynamics of binary metal alloys: Gibbs free energy - Entropy - Enthalpy Binary iron-carbon metal alloy: Phase equilibrium diagram - Eutectoid transformation
Mechanical behaviour of construction materials at room temperature: Elasticity - Plasticity - Ductility - Fragility
Mechanical properties of materials in use and mechanical tests at room temperature
Physical properties of construction materials and associated non-destructive testing
Chemical properties of construction materials and corrosion phenomena

Tutorial topics: 4 tutorials of 1.25 hours each
1/ Crystallography: Pattern - Atomic density - Miller indices
2/ Phase diagram: Iron-carbon diagram - Determination of the microstructure of a steel at room temperature
3/ Mechanical properties: Tensile strength curve and skimming - Strain energy
4/ Chemical properties: Corrosion

Practical work session: 2 TPs of 3 hours each
TP1 Mechanical tests: tensile test - Hardness test - Impact test
TP2 Chemical tests

If the student chooses to approach the objectives with 'Mechanical Engineering' oriented materials

- 35.5 hours for a mechanical design project, through the study of a project in a small group, the students approach functional analysis, modelling (schematisation), the search for solutions, pre-dimensioning and the production of a 'digital mock-up' using CAD software. Students supplement the knowledge they need to develop the project with various documents at their disposal: resource documents on the 'moodle' platform, books, internet.
- 8 hours of practical work on bearing assembly,
- Using the elements made available to them (bearings, gear housing shafts, keys, elastic rings, locknuts, etc.), the students must analyse, design and produce bearing assemblies that comply with current regulations.
- 6 hours on the study and operation of different heat engines. Using visual aids, students discover the different cycles of internal combustion engines, the distribution and supply systems, and the principles of turbojet and turboprop engines. They identify the different functional elements of an engine from an overall drawing.

Materials for Mechanical Engineering - Lesson (7.5h)
- Phase transformations under equilibrium conditions: isothermal (eutectoid and eutectic) and non-isothermal transformations
- Diffusion: Fick's laws (unidirectional)
- Germination-growth mechanisms of a new phase (from a liquid or a solid phase)
- Mechanical properties of metal alloys: fatigue strength and behaviour in the presence of cracks

TD topics (5h)
1: Use of Fick's laws in steel carburising
2: Analysis of the microstructural evolution of steels
3: Work hardening - Introduction to residual stresses
4: Conventional fatigue limit and fatigue diagram (Haig)

Practical work (6h)
TP1 Mechanical test: Effect of cold rolling on tensile properties - Alloy Al20217

TP2 Microstructure: Microstructures of steels and white cast irons

If the student chooses to approach the objectives with 'Civil Engineering' oriented materials
Civil engineering materials: 18.75 h
- 11.25 h Portfolio lecture on construction materials used in civil engineering
- 2.5 h of tutorials on LCA and quantitative approaches
- 5 h of practical work on materials and numerics
Project design part: 52 h
- 7.5 h Lectures on project principles (architecture and structure)
- 8.75 h Tutorials: architectural analysis, load analysis and structural design in relation to construction techniques
- 2 h site visit
- 33.75 h project work in small groups based on project choices and approach, architectural and structural design, justification of choices, digital modelling, quantification, technical design details, definition and calculations of load transfers and environmental impact study of construction materials.

Objectives

- Make the link between the mechanical, physical and chemical properties of construction materials (metals, ceramics and polymers) and the characteristics of these materials on an atomic (crystallographic) and microstructural (binary phase diagram) scale.
- Make a reasoned selection of metallic materials for mechanical construction by making the link between the mechanical characteristics and the nature of the metallic alloy: chemical composition, microstructure, nature of the phases, heat treatment possibilities, etc;
- Implement a design procedure based on specifications and acquire a technological culture.
The student may choose to approach this general objective with either a 'Mechanical Engineering' or a 'Civil Engineering' teaching aid.

If the student chooses to approach the objectives with 'Mechanical Engineering' oriented teaching aids, he/she must :

- Propose one or more solutions in the form of a kinematic diagram, based on a set of specifications.
- Calculate the powers involved and choose a motor.
- Design and size a simple gearbox.
- Design and size a radial contact ball bearing assembly.
- Calculate the isostatism of an assembly of fixed parts and a moving mechanism.
- Produce a digital model of the mechanism using CAD software.
- Give an oral and written presentation of the project.
- Participate and get involved in a work group.
- Identify the links to be implemented using real components for the bearings.
- Be familiar with 4-stroke and 2-stroke cycles.
- Be familiar with distribution and supply systems.
- Be familiar with the principles of turbojet and turboprop engines.
- Be able to identify the functional elements of an engine from a drawing.
- Be familiar with the secondary functions (cooling, lubrication, electrical generation, etc.).
- Be familiar with the terminology of the component parts.

If the student chooses to approach the objectives using 'Civil Engineering' oriented materials, he or she will be able to :
- Develop an interdisciplinary culture around sustainable urban development,
- To immerse themselves in the complexity of civil engineering design projects and in multi-criteria, multi-actor and multi-scale spatial and temporal decision-making.
- Discover the concepts of eco-design
- Design architectural programmes
- Define, select and specify construction materials

- Justify and assess the environmental impact of the solutions prescribed
- Design the load-bearing structure of buildings (vertical loads only)
- Calculating and predicting load transfer (gravity and operational loads only)

This course is designed to be closely linked to the development of skills in civil engineering project methods, the use of digital tools, the development of design project practices, the discovery of architectural design, the choice of construction techniques and materials and the use and development of multi-criteria and quantitative approaches.

The module provides an introduction to the dual Architect/Engineer curriculum, and develops analytical skills and design methods for building projects within an urban fabric. The project also provides an opportunity to practise the concepts of Resistance of Materials 2 seen in S4, with an understanding of beams, loads and the practical application of the principles of statics.

Necessary prerequisites

For the common core of materials: Notion of Crystallography and Thermodynamics from 1A

If the student chooses to approach the objectives with 'Mechanical Engineering' oriented materials
- I2ICTI31 teaching in semester 3 (kinematic diagram, isostatism applied to the assembly of fixed parts, design of an assembly of radial contact ball bearings, knowledge of the rules of industrial drawing, knowing how to use the basic functions of CREO.
- Teaching I2ICME31 in semester 3 (knowing how to use the Fundamental Principle of Statics).

If the student chooses to approach the objectives with 'Civil Engineering' oriented materials
- I2ICTI31 teaching in semester 3 GC BIM design with tools linked to the use of a 3D modeller, technical approach to parametric families and objects, collaborative approach.
- I2ICME31 teaching in semester 3 (knowing how to use the Fundamental Principle of Statics).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Analysis 1

Introducing

Description

• The notion of differentiability of a function of multiple variables, partial derivatives
• The concept of norms, convergence of sequences in vectorial spaces, basic topological concepts: open and closed sets,
• Integrals of functions unbounded or on unbounded domains, with several variables

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
• The notion of differentiability of a function of multiple variables, partial derivatives
• The concept of norms, convergence of sequences in vectorial spaces, basic topological concepts: open and closed sets,
• Integrals of functions unbounded or on unbounded domains, with several variables

The student will be able to:
• Carry out computations of integrals on bounded intervals, of unbounded functions.
• Study the differentiability of a function of multiple (real) variables, carry out an asymptotic expansion
• Manipulate norms of vectors and matrices, study the convergence of a sequence limits in vectors spaces.

Necessary prerequisites

Basic Calculus, Basic Linear algebra

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Algebra

Introducing

Location(s)

Toulouse

Description

Euclidean spaces.
Orthogonal matrices.
Reduction of quadratic shapes.

Objectives

Reduce symmetric endomorphisms.
Manipulate scalar products and understand the notion of orthogonality in euclidean spaces.
Express quadratic forms as sums of squares.

Necessary prerequisites

1st year Mathematics course

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Electromagnetism

Introducing

Description

Course Structure

The course is divided into six main chapters:

1- Magnetostatics:

˚Study of static magnetic fields and magnetic forces.
˚Application of Biot-Savart and Ampère's laws.
˚Analysis of magnetic circuits and magnetic materials.

2- Induction Phenomena:

˚Introduction to Faraday's law and Lenz's law.
˚Study of induced currents and electromotive forces.
˚Practical applications of induction phenomena in transformers and generators.

3- Maxwell's Equations in Vacuum:

˚Derivation and understanding of Maxwell's equations.
˚Relationship between electric and magnetic fields in vacuum.
˚Introduction to electric and magnetic potentials.

4- Electromagnetic Wave Propagation:

˚Study of the propagation of electromagnetic waves in different media.

5-Electromagnetic Energy and the Poynting Vector:

˚Calculation of energy stored in electric and magnetic fields.
˚Introduction to the Poynting vector and its role in the propagation of electromagnetic energy.

6-Study of the Special Case of Monochromatic Progressive Plane Waves:

˚Analysis of progressive plane waves and their properties.
˚Study of monochromatic waves and their polarization.

This course aims to provide a deep understanding of the fundamental concepts of electromagnetism and to develop your analytical and practical skills to solve complex problems in this field.

Objectives

Course Objectives:

1- Master the basic theoretical tools and concepts of electromagnetism, such as Maxwell's equations, induction phenomena, and quasi-stationary regimes. These foundational concepts will lay the groundwork for understanding the propagation of electromagnetic waves, which will be further developed in the following year.
2- Identify relevant variables in problems related to magnetostatics and time-varying electromagnetism.
3- Simplify real-world problems to calculate useful physical quantities.
4- Geometrize any electromagnetism problem in 3D, whether it is in a static or time-varying regime.
5- Extract the full set of physical properties of an electromagnetic wave from Maxwell's equations.

This course aims to provide you with a deep understanding of the fundamental concepts of electromagnetism and to develop your analytical and practical skills to solve complex problems in this field.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Materials

Introducing

Description

- Introduction
- Atomic Structure
- Structures and ordering in condensed matter
- Phase diagrams
- Mechanical properties of crystalline materials
- Ceramics / Polymers
- Electronic properties of materials and their applications (electronic, thermal and optical properties).

Objectives

At the end of this module, the student will be able to:
Describe the main macroscopic properties of materials (mechanical, electronic, thermal, magnetic, dielectric and optical) and identify their origins in terms of structural arrangement and electronic structure.

Necessary prerequisites

No necessary knowledge.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Analog electronics

Introducing

Description

This course is divided into 8 chapters :
Chapter 1: Electronics – a whole world to discover.
Chapter 2: First-year review.
Chapter 3: Diodes, Zener diodes, and LEDs.
Chapter 4: The bipolar transistor in switching applications.
Chapter 5: How to receive a light signal: the photodiode.
Chapter 6: Mathematical tools for the electronics engineer.
Chapter 7: How to filter a signal? Passive filters.
Chapter 8: How to amplify a signal? The linear operational amplifier.

Objectives

This analog electronics course is intended for 2nd-year IMACS students. Its objective is to provide a foundation of knowledge and skills for students who are just beginning in this subject.

Necessary prerequisites

The required concepts are as follows :
- General laws of electrokinetics : Kirchhoff's voltage law, Kirchhoff's current law, Ohm's law, constitutive relation (current/voltage) for capacitors and inductors.
- Thévenin's and Norton's theorems.
- Superposition theorem.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Signal

Introducing

Description

Teaching is organized into 12 class sessions, 12 practical sessions and 3 practical sessions. The course is organized as follows:

1. Introduction; notions of signal, signal processing, system response, filtering

2. Chapter 2 is dedicated to defining the properties of linear time-invariant (LTI) systems, and the concepts of excitation and response. A prerequisite for calculating the response of a system is to find the type of excitation that facilitates this task. We will highlight two types of excitation families: complex exponential and impulse. These will enable us to define two complementary ways of modeling a system: in the time domain by the impulse response, and in the frequency domain by the transfer function.

3. Chapter 3 is devoted to the Laplace transform. This tool, which transforms a mathematical function in time into a new function expressed in the complex frequency domain, provides a highly efficient means of calculating the transient response of LTI systems, whatever the input excitation applied.

4. Chapter 4 deals with frequency analysis and filtering. Filters are LTI systems like any others. Their specific purpose is to eliminate unwanted frequency components from a signal. To design a filter, its transfer function must be analyzed. This chapter introduces a graphical tool for filter analysis: the Bode diagram, as well as the vocabulary associated with filter characterization.

5. Chapter 5 introduces the decomposition of a periodic signal into a series of (co)sinusoidal terms, known as the Fourier series. This forms the basis of frequency signal analysis. After a description of the different forms taken by the series, the main properties of Fourier series are presented. Several examples of signal decomposition in Fourier series are given. A line spectrum representation of the signal is also introduced, providing a powerful graphical analysis tool.

6. Fourier series are a formidable tool for signal analysis, but are limited to periodic signals. The Fourier transform is an extension for a class of non-periodic signals. Chapter 6 is dedicated to presenting the Fourier transform and its application. The chapter also shows that the Fourier transform is a special case of the Laplace transform.

7. Chapter 7 returns to the calculation of the time response of systems. This was covered in Chapter 3, where the signal was transformed into the frequency domain using the Laplace transform. In this chapter, we show how this calculation can be performed directly in the time domain. This requires the use of the convolution product.

8. In the final chapter, we return to the concepts of signal power and energy. We present calculation methods in the time and frequency domains. We introduce another fundamental tool for studying the similarity of signals: correlation. It also has another major interest: knowledge of it enables us to determine the power spectral density of a signal, giving the signal's power distribution in the frequency domain.

Practical sessions are also dedicated to getting to grips with digital signal processing tools (Matlab, Octave).

Objectives

The aim of this course is to introduce the main mathematical concepts, methods and tools for continuous-time signal processing (Laplace, Fourier, convolution, correlation, spectrum, frequency analysis, etc.).

Necessary prerequisites

Mathematics for enginners (trigonometry, complex numbers, integration)

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Feedback systems

Introducing

Description

Outline :
Chapter 1 Introduction to Automation
What is automation
On the notion of system and input/output/disturbance
Determining the I/O of a system
BO vs BF and Setpoint vs Command
Introductory example
The systems considered and the I/O model (linear diff. equation of order n).
Chapter 2 Mathematical tools
Some definitions
time response, step, ramp, Dirac, causality, Analysis, Control, linearity, Invariance
The Laplace transform, a short and useful version
Def., table, derivation=<EDO role of ICs, final value theorem
The notion of transfer function
Chapter 3 Modeling
Why model...How to model
Qq reminders (elec, mech, basic fluid) => Passage to Laplace
Block diagram - Definition and conventio
Simplification and transformation
Linearization
Chapter 4 Time Response
Reminder of simple EDO resolution
Solving by Laplace (simple element decomposition)
1st-order systems
Second-order systems
On the notion of performance: response time, overshoot and accuracy
Other systems (unstable and pole dominance)
On the notion of performance: response time, overshoot and accuracy
Chapter 5 Harmonic response
Why and how
A complex example and introduction to the various plots
The pure integrator and the pure derivator
The first order
Second order
Method for plotting asymptotes for a qcq order
From BO to BF: black's chart

Objectives

Frequency approach to continuous linear control

Necessary prerequisites

Ordinary differential equation
Complex variable

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Expression

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

None

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign Language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional path initiative

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Nanophysics

Introducing

Description

Wave phenomena, interferences and diffraction. Particle phenomena. The dual nature of waves and particles, application to electron microscopy. Quantum physics
laws. Quantum effects and applications. Scanning tunnelling microscope, quantum wells and quantum dots, application to radioactivity, harmonic oscillator, vibrations of molecules and Infrared spectroscopy, kinetic momentum and its application to molecular rotation spectroscopy, spin and its applications in NMR and MRI. Atomic and molecular orbitals. X-rays . Lasers. Crystalline solids, concept of energy bands, application
in semiconductor electronic devices.

Objectives

At the end of this module, the student will have understood and be able to explain :
The fundamentals of wave propagation and quantum physics that are necessary for the understanding of modern electronic devices and analytical techniques
The principle of analytical techniques commonly used in laboratories and the underlying molecular mechanisms of quantum physics

The student will be able to:
Formulate in his own words some nano-scale mechanisms and give concrete examples of micro and nano-devices together with well-known analytical methods using these mechanisms
Master elementary phenomena of nano-scale physics
Select the best method for a specific characterisation on the basis of the acquired concepts.
Carry out some nano-scale characterisation methods
Link mathematical formalism of quantum physics to real applications
Grasp the necessary approximations that are required in quantum physics
Bring together these different concepts to assimilate them, extract them from their context in order to apply them to real situations.

Necessary prerequisites

L1 level in Mechanics, Electrostatics, Optics and Mathematics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Analysis 2

Introducing

Description

Numerical series, power series.

Objectives

At the end of this module, the student will have understood and be able to:
- determine the different kinds of convergence of numerical series.
- study the convergence of power series.

Necessary prerequisites

Analysis lectures of first year

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Location(s)

Toulouse

Practical info

Probabilities and statistics

Introducing

Description

- Random variables (discrete or continuous) and their characteristics
- Multidimensional random variables, conditional distributions and independence
- Limit theorems (LLN and CLT) and approximation of laws
- Statistical estimation, both punctual and using confidence intervals
- Statistical test for mean.

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):
- what a random variable (discrete or continuous) and its characteristics are
- how to apply limit theorems such as the Law of Large Numbers (LLN) or the Central Limit Theorem
(CLT)
- the notion of statistical estimation
- the notion of statistical test.

The student will be able to:

- to determine the law of a random variable, to compute its expectation, variance, cumulative distributive, etc
- to study the independence of random variables
- to approximate distributions by using underlying limit theorems
- to estimate using confidence intervals some unknown parameters (expectation, variance, proportion) associated to a large population
- perform a statistical test for a mean.

Necessary prerequisites

Analysis I and Analysis II

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Elective scientific course

Introducing

Description

Students take one of the following courses, of their choice:
- spatial data acquisition,
- mechanics for health,
- Python for engineers,
- networks and electrical machines.

Objectives

Elective courses are scientific courses related to the content of the pre-orientation, i.e. courses that can be used by future engineers in the Civil Engineering and Mechanical Engineering sectors. These courses are not prerequisites for the rest of the curriculum.

Necessary prerequisites

See detailed descriptions of each course.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Logics

Introducing

Description

This course deals with logic. After introducing Boolean algebra and logical functions, various minimisation methods are discussed. The general structure of a sequential system and elementary sequential systems are also studied (counters, flip-flops, etc.). A method for designing synchronous sequential systems using flip-flops is studied.

Objectives

By the end of this module, students should have understood and be able to explain (key concepts):

- The concepts of combinational and sequential systems,
- The concepts of synchronous and asynchronous systems (circuits),
- The methods for designing and implementing these systems.

Students should be able to:
- Represent and minimise logic functions,
- Design a combinational or sequential logic system.

Necessary prerequisites

none

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Hardware architecture

Introducing

Description

- Functional description of the fundamental components of a conventional processor-based computer and their interactions.
- Description and contextualization of computer architecture models.
- Functional description of the processor, its memory and caches, and associated technologies.
- Hardware-level functional description of paging and memory virtualization.

Objectives

At the end of this module, students will be able to describe how a computer works, based on its internal structural elements, and define the actions required at hardware level to perform a given task.

Necessary prerequisites

Basic notions of algorithmics and logic.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Digital electronics

Introducing

Description

Numerical representation of information (base 2, binary coding, signed numbers, hexadecimal)
Basic digital components: diodes, Zener, LED, trigger, level adaptation circuits
Combinational logic: TTL logic gates, Fan-In, Fan-Out
Synchronous counters, reset circuits
Oscillators (ICM7555), LED blinking
Sampling and analog-to-digital conversion
Prototyping and component selection (BOM, datasheets)

Objectives

Learning Objectives
Acquire fundamentals of digital electronics.
Understand data representation and analog-to-digital conversion.
Design and size logical circuits and digital interfaces.
Explore the operation of digital integrated circuits.
Learning Outcomes
Represent and manipulate digital signals.
Design digital circuit architectures.
Interpret component datasheets.
Analyze and size circuits based on specifications.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Operating systems

Introducing

Description

The command interpreter (the shell), variables, iterative structures, control structures,
Programming using the command language (essentially bash),
Handling the file system and, in particular, access rights,
User management (uid, gid, home directory, etc),
I/O and pipe redirection mechanisms.
Some general information on documentation, archiving, compression and a few network commands.

Objectives

At the end of this module, the student will be able to use the command interface of the Unix operating system independently.

Necessary prerequisites

No required

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Computing

ECTS

Hourly volume
56h

Introducing

Description

Programme (detailed contents):
1- breakdown in sub programs
2- constraint and non constraint arrays
3- recursive algorithms: principle, examples
4- pointers and linked lists

Objectives

At the end of this module, the student will have understood and will be able to explain (main concepts):
- functional breakdown: procedure choice, setting of procedures
- differences between several data structures: arrays, records, pointers and linked lists
- recursive algorithms
- array exploring, sorting and merging

The student will be able to:
- analyze an advanced problem
- breakdown it into subprograms
- choose adapted data structures
- specify (recursive) algorithms
- implement algorithms in ADA language
- specify and realize test cases.

Necessary prerequisites

L1 algorithm lecture.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Physical Activities and Sports

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Analysis 1

Introducing

Description

Series
1. Introduction, Finite and Infinite Series
2. Sums of non negative numbers
3. Rearrangement of series: absolute convergence, semi-convergence
Illustrations: decimal representation of natural numbers, of real numbers, notion of numerical errors

Topology of Normed Vector Spaces
1. Norms, Comparison of Norms
2. Sequences in Normed Spaces and Convergence
3. Topology: open and closed sets, closure, density
4. Limits, continuity of functions, compactness
5. Linear Applications between Normed Vector Spaces
Illustrations: Iterative Methods to solve linear systems, matrix condition number

Several Variable Differential Calculus

1. Derivatives in several variable calculus
2. Partial and directional derivatives
3. Taylor expansion
4. The inverse function theorem, the implicit function theorem
Illustration: Newton method to solve a system of nonlinear equations.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

• The notion of numerical series and convergence of series
• The notion of differentiability of a function of multiple variables, partial derivatives
• The concept of norms, convergence of sequences in vectorial spaces, basic topological concepts: open and closed sets, compactness

The student will be able to:

Use the main mathematical results to
• Study the convergence of numerical series with majoration and comparison methods
• Study the differentiability of a function of multiple (real) variables, carry out an asymptotic expansion
• Manipulate norms of vectors and matrices, study the convergence of a sequence or function limits in vectors spaces.

Necessary prerequisites

Basic Calculus, Basic Linear algebra

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Linear algebra

Introducing

Description

Resolution of linear systems
1. Gauss elimination. Manipulation of rows and columns. Matrix interpretation
2. Existence criterion: rank, kernel, strictly dominant diagonals
3. LU factorization

Prehilbertian and Euclidian spaces
1. Scalar product: examples, properties
2. Orthogonality: orthogonal basis, projections
3. Mean Square solution of linear systems, QR factorization

Reduction of endomorphisms
1. Eigen-elements: eigenvalues, eigenfunctions, characteristic polynom
2. Diagonalisation, trigonalisation, Cayley-Hamilton
3. Applications: linear differential systems and recurrences, spectrum computation

Endomorphisms of Euclidian spaces
1. Isometries, Orthogonal Matrices
2. Adjoint, Self-adjoint endomorphisms, diagonalization
3. Singular Value Decomposition (data visualization)

Hermitian spaces
1. Hermitian product, Orthogonality
2. Endomorphisms of Hermitian spaces: adjoint, reduction.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- Knowing main factorization results on matrices: LU, QR, SVD
- Main results on diagonalization and trigonalization
- Orthogonality
- Adjoint of a matrix, self-adjoint matrices and spectral theorem, Isometries

The student will be able to:

- Solve linear system with Gauss elimination and give a matrix interpretation
- Compute orthogonal basis or orthogonal projection on a subspace
- Provide a matricial interpretation of the main classes of Euclidian endomorphisms
- Diagonalize or trigonalize matrices
- Solve numerically a linear system in a mean square sense. Apply numerical SVD.

Necessary prerequisites

Basic linear algebra: vector spaces, subspaces, linear application, matrix, Kernel and Image of a linear application

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes :

examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Unix

Introducing

Description

The command interpreter (the shell), variables, iterative structures, control structures,
Programming using the command language (essentially bash),
Handling the file system and, in particular, access rights,
User management (uid, gid, home directory, etc),
I/O and pipe redirection mechanisms.
Some general information on documentation, archiving, compression and a few network commands.

Objectives

At the end of this module, the student will be able to use the command interface of the Unix operating system independently.

Necessary prerequisites

No required

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Discrete automatics

Introducing

Description

The second part covers discrete event systems control. It includes the general structure of a sequential system and the study of elementary sequential functions (flip-flops, counters). It also addresses the synthesis and analysis of a sequential logic system. The Huffman method is introduced, as well as simplified sequencer synthesis. The realization will be done using flip-flops for synchronous systems. Additional information is provided on Huffman synthesis for asynchronous sequential logic systems (issues of hazards and races). The formalism of Petri nets is introduced for specifying problems related to parallelism, synchronization, and critical resource management, as well as the statecharts formalism.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
• Sequential logic: synthesis and analysis
The student should be capable of:
• Conducting minimal synthesis and analysis of a sequential system based on flip-flops, including that of a sequencer (synchronous systems).
• Analyzing and synthesizing complex asynchronous sequential logic systems, identifying and resolving issues related to static hazards and races.
• Modeling a system with parallelism, synchronization, and shared resources using the formalism of Petri nets or statecharts, and analyzing properties (safe, live, and sound) of a network through the marking graph.

Necessary prerequisites

Combinatory logic

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Continuous automatics

Introducing

Description

This course deals with the modeling, analysis and control of continuous linear systems. It presents the classical methods of frequency automata. They are based on the transfer function representation, obtained from the Laplace transform. The stability property and their temporal and frequency responses, in the form of Bode and Nyquist diagrams, are studied. We analyze the performance of a servo system, in terms of accuracy, transient regime and stability margins. Finally, the synthesis of correctors is approached by studying the effects of elementary corrections, before combining them to set PI, PID and phase lead controller.

Objectives

At the end of this module, the student should have understood and be able to explain the main concepts of the automatic control of continuous linear systems:
- model a continuous linear system in the form of transfer functions and block diagrams
- calculate the time and frequency responses of a continuous linear system, and analyze its stability
- analyze the main properties of a servo system (stability, transient regime, accuracy and stability margins)
- synthesize, using the classical frequency method, some controller (elementary corrections, PI, PID, phase lead)

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Expression

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

None

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign Language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional path initiative

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Analysis 2

Introducing

Description

Program (detailed contents):

Sequence of functions
1. Pointwise convergence, uniform convergence
2. Properties of the limit function
3. Approximation: interpolation, density
Applications: interpolation, numerical integration
Series of functions
1. Pointwise, uniform, normal convergence
2. Properties of series of functions
3. Power series
Banach Spaces
1. Cauchy sequences, properties
2. Contraction Mapping theorem
3. Series in Banach spaces
Ordinary Differential Equations: Linear case
1. Examples, affine ODEs
2. Linear ODEs with constant coefficients. Phase portraits. Stability
3. Gronwall Lemma
Introduction to Optimization
1. Convexity: definition, examples
2. Symmetric, positive definite matrices
3. Minimization (compactness arguments). Optimality conditions of order 1 and 2.
Integration
1. Integrals of functions on infinite interval or unbounded functions
2. Integrals with parameters: convergence, continuity, differentiability
3. Integrals of several variables: Fubini theorem, Change of variable.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

• Notion of pointwise and uniform convergence
• Notion of completeness and applications
• Integrals of functions unbounded or on unbounded domains, with parameters, with several variables

The student will be able to:
• Study pointwise or uniform convergence of a sequence of functions
• Study functions defined as integrals or series of functions with parameters
• Solve linear ordinary differential equations
• Carry out computations of integrals on bounded intervals, of unbounded functions.
• Find extrema of C^1 or C^2 functions.

Necessary prerequisites

Linear Algebra, Analysis 1

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Probability-Statistics

Introducing

Description

- Probability spaces
- Conditional probability and independence
- Random variables (discrete or continuous) and their characteristics
- Multidimensional random variables, conditional distributions and independence
- Limit theorems (LLN and CLT) and approximation of laws
- Statistical estimation, both punctual and using confidence intervals

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):

- what a probability space is
- the notion of conditional probability and independence between events
- what a random variable (discrete or continuous) and its characteristics are
- how to apply limit theorems such as the Law of Large Numbers (LLN) or the Central Limit Theorem (CLT)
- the notion of statistical estimation

The student will be able to:

- to compute probabilities using Bayes formula
- to determine the law of a random variable, to compute its expectation, variance, cumulative distributive and characteristic functions, etc
- to study the independence of random variables
- to approximate distributions by using underlying limit theorems
- to estimate using confidence intervals some unknown parameters (expectation, variance, proportion) associated to a large population

Necessary prerequisites

Basic set theory, summations and series, derivation, integration (both simple and multiple), improper integrals, equivalents and limit computations.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Signal 1

Introducing

Description

Program (detailed contents):
- Hilbert Spaces : scalar products, projection onto a vector subspace, approximation of a vector in a basis.
- Fourier series : definition, properties, Parseval's theorem and Dirichlet's theorem. Gibbs phenomenon.

Objectives

At the end of this course, the student will have understood and be able to explain (main concepts):
- Fourier coefficients, partial sums and Fourier series of piece-wise continuous functions.
- Various notions of convergence of Fourier Series.

The student will be able to:
- Compute the Fourier coefficients of a function.
- Compute some series and solve equations using Fourier coefficients.

Necessary prerequisites

Integrals, complex numbers, series.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Algorithm and programming 2

Introducing

Description

Abstract types and implementation.
Linear data structures: stacks, queues, linked lists.
Tree-like data structures: binary trees, binary heaps, n-ary trees.
Hash tables.

Objectives

Learn to implement and use classic linear and tree data structures.

Necessary prerequisites

Algorithms and Programming I (previous semester).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Hardware architecture

Introducing

Description

- Functional description of the processor, its memory and caches, and associated technologies.
- Hardware-level functional description of paging and memory virtualization.

Objectives

At the end of this module, students will be able to describe how a computer works, based on its internal structural elements, and define the actions required at hardware level to perform a given task.

Necessary prerequisites

Basic notions of algorithmics and logic.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Language (C)

Introducing

Description

The conventional aspects (variables, types, control structures, iterative structures) are presented as well as the more specific points of the language (bit-by-bit operators, generalised use of pointers, parameter passing, input/output, etc.).

Objectives

At the end of this module, the student should have understood and be able to explain the programming of a particularly widespread computer language (C), including in particular the hardware-related aspects.

Necessary prerequisites

Notions of assembler and programming in an advanced language are welcome, as well as a minimum knowledge of computer architecture.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Elective scientific course

Introducing

Description

Students take one of the following courses, of their choice:
- spatial data acquisition,
- mechanics for health,
- Python for engineers,
- networks and electrical machines.

Objectives

Elective courses are scientific courses related to the content of the pre-orientation, i.e. courses that can be used by future engineers in the Civil Engineering and Mechanical Engineering sectors. These courses are not prerequisites for the rest of the curriculum.

Necessary prerequisites

See detailed descriptions of each course.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Design – CAD

Introducing

Description

3 ECTS: Mechanical Design

Design and understand the architecture of mechanisms.

3 ECTS: Civil Engineering BIM

Model and transition from 2D to 3D.
Apply concepts of construction techniques.

Objectives

The student must be able to:

Define a simple rotational guide.
Specify the assembly of components.
Represent schematically (modeling).
Provide a graphical representation of a mechanism's architecture.
Create 2D and 3D graphical representations.
Model elements of civil engineering projects.
Query a digital model to extract production data.
Understand the mechanical functioning of civil engineering projects.

Necessary prerequisites

Introductory courses on industrial techniques in the first year: I1ANTI11 and I1ANSY21.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Strength of Materials 1

Introducing

Description

Modeling with beam-like structures ;
Internal forces (cohesion forces), Relation between continuum stresses and internal forces, Equilibrium equations (in terms of internal forces) ;
Computing strains, stresses and displacements for the elementary loading cases : axial, bending and torsion.

Objectives

Strength of materials: Introduction to beam theory
- Drawing internal forces diagrams for an isostatic, straight, planar beams.
- Calculate the beam strains and stresses for a few simple loads in the case of a simple section and a slender beam.
- Final objective is to learn how to analyse and design beam-like structural members or machine elements subjected to tension, compression, torsion, and bending.

Necessary prerequisites

Equilibrium equations in terms of forces and moments.
Differential and integral calculus.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Mathematical tools 1

Introducing

Description

Part: Mathematical Concepts
- Generalized integrals and series
- Continuity and differentiability of multivariable functions
- Hessian matrix and optimization

Part: Numerical Analysis
- Introduction to Python and numerical analysis (1 Lab Session)
- Direct resolution of linear systems (Gaussian elimination and LU decomposition)
- Solving nonlinear equations (Bisection, Newton's method, and fixed-point iteration)

Part: Probability and Statistics
- Events, probabilities, conditioning, independence
- Random variables, probability distributions, discrete variables
- Continuous random variables, random vectors
- Statistical inference: point estimation, confidence intervals, and hypothesis testing

Objectives

This Teaching Unit (UE) aims to master the essential concepts and foundational knowledge in mathematics for engineers in Civil Engineering or Mechanical Engineering. The UE is divided into three components with complementary objectives:
1. Mathematical Concepts: Master essential mathematical tools for Civil or Mechanical Engineering.
2. Numerical Analysis: Implement efficient algorithms using Python and analyze their convergence.
3. Probability and Statistics: Understand and apply probabilistic and statistical modeling.

Necessary prerequisites

1st year linear algebra and analysis, programming in Python language

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information

Mechanics

Introducing

Description

Analyze structure equilibrium and apply Newton's second law to a system of rigid bodies:
- Model usual mechanical actions as wrenches using screw theory (kinematic joints and external forces)
- Model friction using Coulomb's Law of Friction
- Model the tilting of a plane joint using a mobile point of application for the normal force
- Identify a statically determinate/indeterminate system (number of static unknowns)
- Determine a solving strategy for the second law (systems of interest, external forces, free body diagram, equations to use, solid bodies subjected to only two external forces)
- Calculate the mechanical actions that need to be determined (joints or actuators)
- Validate the stability of a structure (sliding, tilting on a plane, loss of contact)

Determine the absolute or relative velocity and acceleration of a point on a rigid body:
- Interpret the kinematic parameterization of a mechanism
- Describe the velocity vector field that characterizes a body's motion as a twist using screw theory
- Apply velocity addition, velocity field analysis and time derivatives of vectors in rotating frames
- Determine the condition for rolling without slipping at the contact between two bodies
- Solve a 2D kinematics problem graphically (instantaneous axis of rotation, velocity field)

Objectives

Solid mechanics
At the end of this course, you will be able to:
- determine the mechanical loads exerted on rigid bodies (preliminary step to sizing),
- verify the stability conditions of a mechanism (friction, tilting, loss of contact),
- analyze velocities and accelerations in a mechanism (particularly in power transmissions).

Necessary prerequisites

- Reading a kinematic diagram
- Solving systems of algebraic equations
- Trigonometry and projections
- Vectors, scalar and vector products
- Derivatives of composite functions

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Expression

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

None

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Foreign Language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional path initiative

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Mathematical tools 2

Introducing

Description

Linear Algebra

Eigen-elements: eigenvalues, eigenvectors, characteristic polynomial

Diagonalization

Applications

Euclidean Spaces

Scalar product: examples, properties

Orthogonality: Pythagoras theorem, orthogonal bases, orthogonal projection

Bilinear Algebra

Bilinearity

Symmetric positive definite matrices: definition, properties, characterization

Ordinary Differential Equations (ODEs) – Linear

Examples, general framework of affine ODEs

Special case of linear ODEs with constant coefficients

Multivariable Functions

Notion of differential for multivariable functions

First- and second-order optimality conditions

Multiple integrals

Numerical Analysis

Numerical resolution of ODEs

Interpolation

Numerical integration

Least squares method

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Knowledge of the main results in matrix reduction

Understanding the concept of scalar product and orthogonality

Basic notions of bilinear algebra

The concept of the differential of a multivariable function and partial derivatives

Solving linear differential equations with or without a forcing term

Calculations of integrals of functions of several variables

Finding extrema of a function

The least squares method

Numerical interpolation

Numerical integration

Numerical resolution of differential equations

List of competencies:
Code Competency
1_1 Master mathematical concepts and computational tools relevant to engineering
1_2 Develop rigorous scientific reasoning and the capacity for abstraction
2_1 Master the fundamental tools of the mathematical engineer
(Competency matrix of CTI, 2019)

Necessary prerequisites

Linear algebra and first-year analysis, programming in Python.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Dynamics

Introducing

Description

- Analyze the spatial mass distribution of a rigid body (inertia matrix, center of mass).

Newton's first law of motion for a system of rigid bodies:
- Determine the linear and angular momentum and their time derivatives using screw theory
- Determine a solving strategy to apply the first law (systems of interest, equations to be used)
- Determine mechanical actions or differential equations of motion by applying the first law

Work-energy theorem for a system of rigid bodies:
- Calculate the kinetic energy of a body in motion (rotation, translation, helical motion)
- Determine the power of external forces and contact forces
- Derive an equation of motion or determine a force using the work-energy theorem (WET)

Objectives

Rigid body dynamics
At the end of this course, you will be able to:
- Determine the motion of a mechanism over time given the forces acting on it,
- Determine the mechanical actions in the joints or actuators required to produce the desired motion.
Newton's first law of motion and the work-energy theorem (WET) will be used

Necessary prerequisites

Solid mechanics I course:
- Force and moment calculation
- Common forces modeling
- Calculation of velocity and acceleration
- Screw theory: modeling forces as wrenches and velocity fields as twists
- Solving a statics problem

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Strength of Materials II

Introducing

Description

Beam theory:
• Transition from the real system to the beam type model: average line and geometric properties of sections, connections, loading, linear elastic material;
• Static reminders – Balance – Linking actions – Isostaticity and hyperstaticity;
• Internal forces: normal force, bending, shear force, torsion;
• Stress/strain/displacement fields and potential energy of elastic deformation associated with the different internal forces;
• Methods for solving hyperstatic structures (by application of the superposition principle and Castigliano's theorem).

Objectives

The student will be able to assess:
The mechanical behavior of isostatic and hyperstatic "beam" type structures under static loading:
- Model a "beam" type structure (geometric characteristics, support and loading),
- Calculate the support actions and internal forces,
- Calculate the stress, deformation and displacement fields associated with each type of internal force,
- Calculate the potential energy of elastic deformation,
- Apply resolution methods for hyperstatic structure of degree 1.

Necessary prerequisites

Mechanics
Materials science
Mathematical tools

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Materials science

Introducing

Description

Detailed programme for common materials:

6 CMs of 1.25h each
Crystallography of metals and ceramics - Amorphous structures
Thermodynamics of binary metal alloys: Gibbs free energy - Entropy - Enthalpy Binary iron-carbon metal alloy: Phase equilibrium diagram - Eutectoid transformation
Mechanical behaviour of construction materials at room temperature: Elasticity - Plasticity - Ductility - Fragility
Mechanical properties of materials in use and mechanical tests at room temperature
Physical properties of construction materials and associated non-destructive testing
Chemical properties of construction materials and corrosion phenomena

Tutorial topics: 4 tutorials of 1.25 hours each
1/ Crystallography: Pattern - Atomic density - Miller indices
2/ Phase diagram: Iron-carbon diagram - Determination of the microstructure of a steel at room temperature
3/ Mechanical properties: Tensile strength curve and skimming - Strain energy
4/ Chemical properties: Corrosion

Practical work session: 2 TPs of 3 hours each
TP1 Mechanical tests: tensile test - Hardness test - Impact test
TP2 Chemical tests

Objectives

Make the link between the mechanical, physical and chemical properties of construction materials (metals, ceramics and polymers) and the characteristics of these materials on an atomic (crystallographic) and microstructural (binary phase diagram) scale.

Necessary prerequisites

For the common core of materials: Notion of Crystallography and Thermodynamics from 1A

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Building Environment and Materials

Introducing

Description

Materials for Civil Engineering: 18.75 hours

11.25 hours: Lectures on the portfolio of construction materials used in Civil Engineering.
2.5 hours: Tutorials on Life Cycle Assessment (LCA) approaches and quantitative methods.
5 hours: Laboratory sessions on materials and digital tools.

Project Design Component: 52 hours

7.5 hours: Lectures on design principles (Architecture and Structure).
8.75 hours: Tutorials on architectural analysis, load paths, and structural design linked to construction techniques.
2 hours: Construction site visit.
33.75 hours: Small-group project work, focusing on project selection and approach, architectural and structural design, justification of choices, numerical modeling, quantification, technical design details, defining and calculating load transfers, and assessing the environmental impact of construction materials.

Objectives

The student must be able to:

Understand and develop materials used in Civil Engineering.
Develop an interdisciplinary understanding of sustainable urban development.
Navigate the complexity of civil engineering design projects and apply multicriteria, multi-stakeholder, and multi-scale spatial and temporal decision-making frameworks.
Explore the concepts of eco-design.
Manage the design of architectural programs.
Define, select, and specify construction materials.
Justify and assess the environmental impact of prescribed solutions.
Design the load-bearing structure of buildings (limited to vertical loads).
Calculate and predict load transfers (restricted to gravitational and operational loads).

This course is designed to:

Facilitate the development of skills in civil engineering project methods.
Promote the use of digital tools.
Enhance practices in design projects.
Introduce architectural design principles.
Provide guidance on the selection of construction techniques and materials.
Develop quantitative and multicriteria approaches.

The module aims to:

Present the dual Architect-Engineer curriculum.
Foster analytical thinking and design methodologies for building projects integrated within an urban fabric.
Serve as a practical application of concepts from Strength of Materials 2 (covered in semester 4), specifically focusing on the understanding of beams, loads, and the concrete application of static principles.

Necessary prerequisites

"Civil Engineering Design with BIM: Utilizing a 3D modeling tool, focusing on the technical approach to parametric families and objects, and emphasizing collaborative workflows.
Strength of Materials 1 (SOM 1): Ability to apply the Fundamental Principle of Statics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Design and Materials Project

Introducing

Description

Detailed programme for common materials:

6 CMs of 1.25h each
Crystallography of metals and ceramics - Amorphous structures
Thermodynamics of binary metal alloys: Gibbs free energy - Entropy - Enthalpy Binary iron-carbon metal alloy: Phase equilibrium diagram - Eutectoid transformation
Mechanical behaviour of construction materials at room temperature: Elasticity - Plasticity - Ductility - Fragility
Mechanical properties of materials in use and mechanical tests at room temperature
Physical properties of construction materials and associated non-destructive testing
Chemical properties of construction materials and corrosion phenomena

Tutorial topics: 4 tutorials of 1.25 hours each
1/ Crystallography: Pattern - Atomic density - Miller indices
2/ Phase diagram: Iron-carbon diagram - Determination of the microstructure of a steel at room temperature
3/ Mechanical properties: Tensile strength curve and skimming - Strain energy
4/ Chemical properties: Corrosion

Practical work session: 2 TPs of 3 hours each
TP1 Mechanical tests: tensile test - Hardness test - Impact test
TP2 Chemical tests

If the student chooses to approach the objectives with 'Mechanical Engineering' oriented materials
- 35.5 hours for a mechanical design project, through the study of a project in a small group, the students approach functional analysis, modelling (schematisation), the search for solutions, pre-dimensioning and the production of a 'digital mock-up' using CAD software. Students supplement the knowledge they need to develop the project with various documents at their disposal: resource documents on the 'moodle' platform, books, internet.
- 8 hours of practical work on bearing assembly,
- Using the elements made available to them (bearings, gear housing shafts, keys, elastic rings, locknuts, etc.), the students must analyse, design and produce bearing assemblies that comply with current regulations.
- 6 hours on the study and operation of different heat engines. Using visual aids, students discover the different cycles of internal combustion engines, the distribution and supply systems, and the principles of turbojet and turboprop engines. They identify the different functional elements of an engine from an overall drawing.

Materials for Mechanical Engineering - Lesson (7.5h)
- Phase transformations under equilibrium conditions: isothermal (eutectoid and eutectic) and non-isothermal transformations
- Diffusion: Fick's laws (unidirectional)
- Germination-growth mechanisms of a new phase (from a liquid or a solid phase)
- Mechanical properties of metal alloys: fatigue strength and behaviour in the presence of cracks

TD topics (5h)
1: Use of Fick's laws in steel carburising
2: Analysis of the microstructural evolution of steels
3: Work hardening - Introduction to residual stresses
4: Conventional fatigue limit and fatigue diagram (Haig)

Practical work (6h)

TP1 Mechanical test: Effect of cold rolling on tensile properties - Alloy Al20217
TP2 Microstructure: Microstructures of steels and white cast irons

If the student chooses to approach the objectives with 'Civil Engineering' oriented materials
Civil engineering materials: 18.75 h
- 11.25 h Portfolio lecture on construction materials used in civil engineering
- 2.5 h of tutorials on LCA and quantitative approaches
- 5 h of practical work on materials and numerics
Project design part: 52 h
- 7.5 h Lectures on project principles (architecture and structure)
- 8.75 h Tutorials: architectural analysis, load analysis and structural design in relation to construction techniques
- 2 h site visit
- 33.75 h project work in small groups based on project choices and approach, architectural and structural design, justification of choices, digital modelling, quantification, technical design details, definition and calculations of load transfers and environmental impact study of construction materials.

Objectives

- Make the link between the mechanical, physical and chemical properties of construction materials (metals, ceramics and polymers) and the characteristics of these materials on an atomic (crystallographic) and microstructural (binary phase diagram) scale.
- Make a reasoned selection of metallic materials for mechanical construction by making the link between the mechanical characteristics and the nature of the metallic alloy: chemical composition, microstructure, nature of the phases, heat treatment possibilities, etc;
- Implement a design procedure based on specifications and acquire a technological culture.
The student may choose to approach this general objective with either a 'Mechanical Engineering' or a 'Civil Engineering' teaching aid.

If the student chooses to approach the objectives with 'Mechanical Engineering' oriented teaching aids, he/she must :

- Propose one or more solutions in the form of a kinematic diagram, based on a set of specifications.
- Calculate the powers involved and choose a motor.
- Design and size a simple gearbox.
- Design and size a radial contact ball bearing assembly.
- Calculate the isostatism of an assembly of fixed parts and a moving mechanism.
- Produce a digital model of the mechanism using CAD software.
- Give an oral and written presentation of the project.
- Participate and get involved in a work group.
- Identify the links to be implemented using real components for the bearings.
- Be familiar with 4-stroke and 2-stroke cycles.
- Be familiar with distribution and supply systems.
- Be familiar with the principles of turbojet and turboprop engines.
- Be able to identify the functional elements of an engine from a drawing.
- Be familiar with the secondary functions (cooling, lubrication, electrical generation, etc.).
- Be familiar with the terminology of the component parts.

If the student chooses to approach the objectives using 'Civil Engineering' oriented materials, he or she will be able to :
- Develop an interdisciplinary culture around sustainable urban development,
- To immerse themselves in the complexity of civil engineering design projects and in multi-criteria, multi-actor and multi-scale spatial and temporal decision-making.
- Discover the concepts of eco-design
- Design architectural programmes
- Define, select and specify construction materials

- Justify and assess the environmental impact of the solutions prescribed
- Design the load-bearing structure of buildings

(vertical loads only)
- Calculating and predicting load transfer (gravity and operational loads only)

This course is designed to be closely linked to the development of skills in civil engineering project methods, the use of digital tools, the development of design project practices, the discovery of architectural design, the choice of construction techniques and materials and the use and development of multi-criteria and quantitative approaches.

The module provides an introduction to the dual Architect/Engineer curriculum, and develops analytical skills and design methods for building projects within an urban fabric. The project also provides an opportunity to practise the concepts of Resistance of Materials 2 seen in S4, with an understanding of beams, loads and the practical application of the principles of statics.

Necessary prerequisites

For the common core of materials: Notion of Crystallography and Thermodynamics from 1A

If the student chooses to approach the objectives with 'Mechanical Engineering' oriented materials
- I2ICTI31 teaching in semester 3 (kinematic diagram, isostatism applied to the assembly of fixed parts, design of an assembly of radial contact ball bearings, knowledge of the rules of industrial drawing, knowing how to use the basic functions of CREO.
- Teaching I2ICME31 in semester 3 (knowing how to use the Fundamental Principle of Statics).

If the student chooses to approach the objectives with 'Civil Engineering' oriented materials
- I2ICTI31 teaching in semester 3 GC BIM design with tools linked to the use of a 3D modeller, technical approach to parametric families and objects, collaborative approach.
- I2ICME31 teaching in semester 3 (knowing how to use the Fundamental Principle of Statics).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Thermodynamics

Introducing

Description

Fundamental concepts (concept of systems, evolution of a system, mathematical tools in thermodynamics, ideal gas model). Work and heat. The first law of thermodynamics and the internal energy function. The enthalpy function and the steady-state systems. Thermodynamic functions changes during reactions. Thermodynamic machines (heat engines).

Objectives

At the end of this module, students should have understood and be able to explain:
- the inductive approach, specific to thermodynamics, which is to generalize, by defining them as laws, the conditions for energy conservation and evolution of systems;
- the significance, the relevance and the application areas of the main thermodynamic functions (internal energy, enthalpy, entropy and Gibbs function).

Students should be able to:
- identify the system under study and to establish, for this system, routinely and systematically, the material balance, the energy balance and the balance of entropy;
- explain the operation of thermodynamic machines, based on the two laws of thermodynamics and on phases equilibria.

Necessary prerequisites

Math: Concept of function of several variables and partial derivatives.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Analysis 1

Introducing

Description

Integration

Improper integrals: integrals of positive functions, functions of any sign, absolute convergence and semi-convergence

Parameter-dependent integrals: dominated convergence theorem, continuity, differentiability

Multiple integrals: Fubini's theorem, change of variable theorem

Numerical Series

Introduction, partial sums and summation techniques

Series with positive terms, comparison theorem

Series with arbitrary terms: absolute convergence, alternating series test

List of Competencies:
1_1: Master the mathematical concepts and computational tools of the engineer
1_2: Establish rigorous scientific reasoning and develop the capacity for abstraction
2_1: Master the fundamental tools of the mathematical engineer

Objectives

The student shall be able to:

Study the differentiability of a function of several variables and perform a limited (Taylor) expansion

Perform integral calculations of functions of several variables or over unbounded domains

Search for extrema of a function of class C1C1 or C2C2

Study the convergence of a numerical series using bounding and comparison methods

The student shall have understood and be able to explain (main concepts):

The notion of the differential of a function of several variables, partial derivatives, and their relation to the differential

The notion of improper integrals, integrals of parameter-dependent functions or of functions of several variables

The notion of numerical series and the concept of convergence of numerical series

Necessary prerequisites

First-year Linear Algebra: Vector spaces, linear maps, matrices, concept of image and kernel of a linear map.
First-year Analysis Course: Functions, limits, continuity, differentiability in one dimension, linear algebra (vector spaces, linear maps, matrices, vectors).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Algebra

Introducing

Description

Solving Linear Systems

Gaussian elimination, row and column operations, matrix interpretation

Pre-Hilbert and Euclidean Spaces

Scalar product: examples and properties

Orthogonality: Pythagoras' theorem, orthogonal bases, orthogonal projection

Reduction of Endomorphisms

Eigen-elements: eigenvalues, eigenvectors, characteristic polynomial

Diagonalization, triangularization

Applications: differential systems and linear recurrences

Endomorphisms of Euclidean Spaces

Isometries, orthogonal matrices

Reduction

Bilinear Algebra

Symmetric positive definite matrices: definition, properties, characterization

Orthogonality

List of Competencies:

1_1: Master the mathematical concepts and computational tools of the engineer

1_2: Develop rigorous scientific reasoning and the capacity for abstraction

2_1: Master the fundamental tools of the mathematical engineer

Objectives

The student should be able to:

Solve linear systems using row and column operations and provide a matrix-based interpretation.

Compute an orthogonal basis and perform orthogonal projections.

Provide a matrix interpretation of the main classes of endomorphisms in Euclidean spaces.

Diagonalize and triangularize simple matrices.

The student should have understood and be able to explain (main concepts):

The main results concerning matrix reduction.

The concept of scalar product and orthogonality.

The notion of Euclidean space and isometry.

Necessary prerequisites

First-year Linear Algebra: Vector spaces, linear maps, matrices, the concepts of image and kernel of a linear transformation.

First-year Analysis: Functions, limits, continuity, differentiability in one dimension, linear algebra (vector spaces, linear maps, matrices, vectors).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Continuous automatics

Introducing

Description

This course deals with the modeling, analysis and control of continuous linear systems. It presents the classical methods of frequency automata. They are based on the transfer function representation, obtained from the Laplace transform. The stability property and their temporal and frequency responses, in the form of Bode and Nyquist diagrams, are studied. We analyze the performance of a servo system, in terms of accuracy, transient regime and stability margins. Finally, the synthesis of correctors is approached by studying the effects of elementary corrections, before combining them to set PI, PID and phase lead controller.

Objectives

At the end of this module, the student should have understood and be able to explain the main concepts of the automatic control of continuous linear systems:
- model a continuous linear system in the form of transfer functions and block diagrams
- calculate the time and frequency responses of a continuous linear system, and analyze its stability
- analyze the main properties of a servo system (stability, transient regime, accuracy and stability margins)
- synthesize, using the classical frequency method, some controller (elementary corrections, PI, PID, phase lead)

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information

Discrete automatics

Introducing

Description

The second part covers discrete event systems control. It includes the general structure of a sequential system and the study of elementary sequential functions (flip-flops, counters). It also addresses the synthesis and analysis of a sequential logic system. The Huffman method is introduced, as well as simplified sequencer synthesis. The realization will be done using flip-flops for synchronous systems. Additional information is provided on Huffman synthesis for asynchronous sequential logic systems (issues of hazards and races). The formalism of Petri nets is introduced for specifying problems related to parallelism, synchronization, and critical resource management, as well as the statecharts formalism.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):
• Sequential logic: synthesis and analysis
The student should be capable of:
• Conducting minimal synthesis and analysis of a sequential system based on flip-flops, including that of a sequencer (synchronous systems).
• Analyzing and synthesizing complex asynchronous sequential logic systems, identifying and resolving issues related to static hazards and races.
• Modeling a system with parallelism, synchronization, and shared resources using the formalism of Petri nets or statecharts, and analyzing properties (safe, live, and sound) of a network through the marking graph.

Necessary prerequisites

Combinatory logic

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Electrostatics (Elective course)

Introducing

Description

Mathematics needed to solve problems
Electric charge and distribution of electric charges
Electric field
Electric potential
Gauss's theorem

Objectives

Acquisition of the basics of electrostatics.
Learning formalism, implementation of scientific reasoning and calculation methods.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Algorithmics and Programming 1

Introducing

Description

Formal study of algorithms (expression, correction, complexity).
Recursion.
Good programming practices.
Memory management.
ADA and Python programming languages.

Objectives

Learn to decompose the development of a program, from the expression of an algorithm on paper to its implementation in different languages.

Necessary prerequisites

First-year algorithmic course at INSA :
- basics of imperative algorithmics: variable, instruction, conditional branching, loop, sub-algorithm,
- ADA programming: syntax, typing.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Unix

Introducing

Description

The command interpreter (the shell), variables, iterative structures, control structures,
Programming using the command language (essentially bash),
Handling the file system and, in particular, access rights,
User management (uid, gid, home directory, etc),
I/O and pipe redirection mechanisms.
Some general information on documentation, archiving, compression and a few network commands.

Objectives

At the end of this module, the student will be able to use the command interface of the Unix operating system independently.

Necessary prerequisites

No required

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Combinatorial logic

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Electronic systems for communication

Introducing

Description

The objective of this course is to introduce the fundamentals of analog and digital electronic systems used by engineers designing electronic communications systems. Organized into thirteen sections, the course aims to cover the analog and digital functions typical of a telecommunications system, such as that of a cell phone. The signal conditioning aspect is addressed by presenting various analog filter structures, with the canonical expressions demonstrated. Operational amplifiers (Op Amps) are studied in linear mode in Laplace space, followed by their study in saturated mode.

The second part of the course covers the concepts of digital electronics: combinational and sequential logic, gates, flip-flops, registers, multiplexers, converters, and memories. The connection to digital signal processing is introduced through CAN and DAC architectures. The issue of communication and interfacing between different logic families is analyzed, associating communication protocols with transmission modes (synchronous, asynchronous, duplex, etc.).

Objectives

At the end of this module, the student should have understood and be able to explain the following main concepts:
- Basic concepts of signal processing (amplification, filtering, Fourier transform)
- Operation of an ideal amplifier and limitations of a real operational amplifier
- Basic Op Amp-based analog electronics setups
- Linear and saturated operating conditions of an Op Amp-based circuit
- The difference between analog and digital electronics
- Basic principles of analog-to-digital conversion (sampling, quantization, Shannon's theorem)
- Physical characteristics of digital circuits
- Gate and flip-flop architectures of simple digital circuits (counter, register, multiplexer)
- Basic principles of digital signal transmission
- Basic principles of analog and digital modulation

The student should be able to:
- Calculate the Laplace transform of the transfer function of an analog circuit
- Design a first-order filter
- Design a simple Op Amp-based analog function (amplifier, integrator, summing circuit)
- Set up an analog-to-digital conversion chain
- Wire analog and digital circuits

Necessary prerequisites

General laws of electricity.
Signal processing basics (Fourier transform, frequency domain representation).
Logic systems.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit,

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évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Expression

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Contemporary economy and ecological transition

Introducing

None

Description

The main areas studied are as follows:

- The market
- Economic actors
- Income and distribution
- Economic growth
- Unemployment
- Financing the economy
- Currency and inflation
- Economic policies
- New economic models

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Objectives

The objective of this course is to provide basic concepts allowing students to better understand their current and future environment and to identify the main issues.

Students will be able to carry on a conversation and debate using arguments based on knowledge of fundamental economic mechanisms and some theories of economic thought.

Necessary prerequisites

Foreign Language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Internship defense

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional path initiative

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physical Activities and Sports

Introducing

Description

The APS (Physical and Sports Activities) offering is structured around several categories:

Team sports: football, basketball, volleyball

Individual sports: tennis, badminton, climbing, judo, strength training, gymnastics

Artistic and expressive activities: circuit training, dance

Outdoor activities: outdoor physical and nature-based activities (OPNA), golf

Adapted sports: adapted strength training, learn-to-swim, learn-to-ride, Pilates, sophrology

At the beginning of the academic year, students use a dedicated platform ("choix APS") to rank the available APS options in order of preference. Each student is then assigned an activity based on their choices and availability.

All APS sessions are supervised by certified PE teachers, either permanent staff (CAPEPS, AGREGATION holders) or external instructors.

Objectives

At the end of this module, the student should have understood and be able to explain the following key concepts:

Deepened self-awareness.

Ability to interact effectively with others.

The student should be able to:

Analyze a problem collaboratively (identify the issue, define possible approaches through interactive discussion).

Facilitate group expression and decision-making, allowing everyone to share their opinion.

Adjust and regulate their behavior in response to others.

Identify their own strengths and weaknesses, as well as those of others.

Apply these insights in the context of physical and sports practice.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information

Signal 1

Introducing

Description

Program (detailed contents):
- Hilbert Spaces : scalar products, projection onto a vector subspace, approximation of a vector in a basis.
- Fourier series : definition, properties, Parseval's theorem and Dirichlet's theorem. Gibbs phenomenon.

Objectives

At the end of this course, the student will have understood and be able to explain (main concepts):
- Fourier coefficients, partial sums and Fourier series of piece-wise continuous functions.
- Various notions of convergence of Fourier Series.

The student will be able to:
- Compute the Fourier coefficients of a function.
- Compute some series and solve equations using Fourier coefficients.

Necessary prerequisites

Integrals, complex numbers, series.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Energy Mix and Transition

Introducing

Description

The main concepts covered during the course are: conversion, transport, storage and usage efficiencies / power flux density / material resource intensity / load factor / stock and flow concepts / production and demand profiles / networking / energy mix / energy transition scenarios for 2050.
The course covers the following technologies: wind generation, electrolytic storage (H2), photovoltaics, electrochemical batteries, hydroelectricity / WWTP, fossil-nuclear-biomass power stations, biogas production.

Objectives

To understand the stakes involved in supplying energy to our production system.
To be able to answer the following questions:
- How do we obtain our energy today (knowing the different means of conversion and storage, and the different mixes) ?
- What are the orders of magnitude for our individual and national energy consumption on a day-to-day basis ?
- Where are the dependencies, weaknesses and limits of our energy supply ?
- How can we build an energy mix that meets our demand profile up to 2050 and the challenge of decarbonization ?

Necessary prerequisites

Be familiar with the concepts of electrical power and energy, as well as the general concepts of efficiency and density.
Have acquired the knowledge and skills of the first year at INSA, especially in electrokinetics, mechanics and thermodynamics.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Analysis 2

Introducing

Description

Sequences of Functions

Pointwise convergence, uniform convergence

Properties of limits of functions

Series of Functions

Pointwise, uniform, and normal convergence

Properties of series of functions

Case of power series

Linear Ordinary Differential Equations (ODEs)

Examples, general framework of affine ODEs

Particular case of linear ODEs with constant coefficients

Objectives

The student should be able to:

Study the pointwise and uniform convergence of a sequence and a series of functions

Analyze functions defined as sums

Solve linear differential equations with or without a forcing term

Solve linear systems of differential equations with or without a forcing term

Necessary prerequisites

First-year linear algebra: vector spaces, linear maps, matrices, the concepts of image and kernel of a linear transformation.
Manipulation of sets, calculations of sums and numerical series, derivatives, integrals (single and multiple), improper integrals, equivalent expressions, and limits.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Probability and statistics 1

ECTS

Hourly volume
26h

Introducing

Description

Program (detailed contents):

- Probability spaces

- Conditional probability and independence

- Random variables (discrete or continuous) and their characteristics

- Multidimensional random variables, conditional distributions and independence

- Limit theorems (LLN and CLT) and approximation of laws

Objectives

At the end of this module, the student should have understood and be able to explain (main concepts):

- what a probability space is

- the notion of conditional probability and independence between events

- what a random variable (discrete or continuous) and its characteristics are

- how to apply limit theorems such as the Law of Large Numbers (LLN) or the Central Limit Theorem (CLT)

The student will be able to:

- to compute probabilities using Bayes formula

- to determine the law of a random variable, to compute its expectation, variance, cumulative distributive and characteristic functions, etc

- to study the independence of random variables

- to approximate distributions by using underlying limit theorems

Necessary prerequisites

Basic set theory, summations and series, derivation, integration (both simple and multiple), improper integrals, equivalents and limit computations.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Algorithm and programming 2

Introducing

Description

Abstract types and implementation.
Linear data structures: stacks, queues, linked lists.
Tree-like data structures: binary trees, binary heaps, n-ary trees.
Hash tables.

Objectives

Learn to implement and use classic linear and tree data structures.

Necessary prerequisites

Algorithms and Programming I (previous semester).

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Hardware architecture

Introducing

Description

- Functional description of the processor, its memory and caches, and associated technologies.
- Hardware-level functional description of paging and memory virtualization.

Objectives

At the end of this module, students will be able to describe how a computer works, based on its internal structural elements, and define the actions required at hardware level to perform a given task.

Necessary prerequisites

Basic notions of algorithmics and logic.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Language (C)

Introducing

Description

The conventional aspects (variables, types, control structures, iterative structures) are presented as well as the more specific points of the language (bit-by-bit operators, generalised use of pointers, parameter passing, input/output, etc.).

Objectives

At the end of this module, the student should have understood and be able to explain the programming of a particularly widespread computer language (C), including in particular the hardware-related aspects.

Necessary prerequisites

Notions of assembler and programming in an advanced language are welcome, as well as a minimum knowledge of computer architecture.

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Digital culture and skills 1

Introducing

Description

Introductory course to AI: history, algorithms, issues.
"No code" discovery of neural networks on Vittascience; notebook for building a small character recognition network.
Presentation of PIX and study of a certain number of themes independently with the objective of passing the PIX certification at the end of the 3rd year.

Objectives

At the end of this module, the student will have discovered the first dimensions of the field of AI: history, examples of what AI allows, distinction between supervised and unsupervised learning, rapid scope of techniques and algorithms, ethical aspects, risks and controversies. In a second part, the student will have advanced his PIX course according to the defined program.

Necessary prerequisites

Basics of Python Programming

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Mathematics tools (elective course)

Introducing

Description

Detailed Programme:
Topology
1. Sequences in a normed vector space (NVS)
2. Topology: open and closed sets, closure, density
3. Limits, continuity of functions, compactness (Bolzano) and Heine theorems
4. Linear maps between NVS: continuity, operator norms
Numerical Analysis
1. Concept of numerical error, floating-point number representation
2. LU and Cholesky factorization, matrix conditioning
3. Singular Value Decomposition (SVD)
4. Least squares solutions to Ax=bAx = bAx=b, QR factorization
5. Power method
6. Newton's method for solving F(X)=0F(X) = 0F(X)=0
7. Fixed-point method (lab work)
8. Numerical integration
9. Gradient method
Probability and Statistics
• Multidimensional random variables, conditional distributions, and independence

Objectives

List of Competencies:
• 1_1: Master mathematical concepts and computational tools relevant to engineering.
• 1_2: Develop rigorous scientific reasoning and abstraction skills.
• 2_1: Master the fundamental tools of the mathematical engineer.
(Based on the CTI Competency Framework, 2019)

Necessary prerequisites

• Working with sets, computing sums and numerical series, derivatives, integrals (single and multiple), improper integrals, equivalent expressions, and limits
• Programming in Python

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Physics 2 (elective course)

Introducing

Description

Materials: Introduction to Materials Science

Atomistics (electronic structure)

Structure and concept of order in matter

Crystalline matter (lattices / perfect crystal and real crystal / crystalline defects + concept of microstructure)

Mechanical properties of crystalline materials (tensile test / elastic deformation / plastic deformation / fracture)

Electromagnetism:

Supplementary electrokinetics for magnetostatics

Lorentz force and Laplace force

Magnetostatics (Biot–Savart law, Ampère's theorem)

Introduction to electromagnetism: Quasi-static approximation (ARQS) and induction phenomena

Brief introduction to waves (general concepts, harmonic waves, progressive and stationary waves, interference and diffraction)

Prerequisite: Electrostatics
Supplementary Control Engineering:

This course deals with sequential logic. The general structure of a sequential system and basic sequential systems (counters, flip-flops) are studied. A method for designing synchronous sequential systems with implementation via flip-flops is covered.
This course prepares for and includes three practical lab sessions.

Objectives

Course Objective:
The aim of this course is to provide students with additional physics knowledge, especially for those who wish to continue their studies in AE (Automatic Engineering) or GP (General Physics).

The course covers three subjects:

Materials:
At the end of this course, students should be able to describe the main macroscopic mechanical properties of materials and identify their microscopic origins related to the structural arrangement of matter.

Electromagnetism:
Introduction to waves and induction phenomena.

Supplementary Control Engineering:
At the end of this module, the student should understand and be able to explain:

The concepts of sequential systems

The methods for designing and implementing these systems

The student should be able to:

Design a sequential logic system

Additionally, the student should have applied the concepts seen in Continuous Control:

System modeling

System performance analysis

Implementation of controllers

Necessary prerequisites

Electrostatics

Combinational Logic

Continuous Control

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 1

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Foreign language 2

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Professional Path Initiative 2nd Year

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Physical Activities and Sports

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

Non-contractual information