

SEMESTER 4_2nd YEAR FAS NUMERICAL

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

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 $Ax=b$, QR factorization
5. Power method
6. Newton's method for solving $F(X)=0$
7. Fixed-point method (lab work)
8. Numerical integration
9. Gradient method

Probability and Statistics

- Multidimensional random variables, conditional distributions, and independence

- 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

Objectives

List of Competencies:

- 1_1: Master mathematical concepts and computational tools relevant to engineering.
- 1_2: Develop rigorous scientific reasoning and abstraction skills.

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

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