

2nd YEAR MODELING, INFORMATICS AND COMMUNICATIONS

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

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

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

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

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

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

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

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

Location(s)

 Toulouse

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

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.

Practical info

Location(s)

 Toulouse

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...

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

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