

MATHEMATICS 2 FIELD_11 ECTS

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 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

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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.

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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.

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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.

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