MATHEMATICS AND ENERGY FIELD_9 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

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES 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.

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Practical info

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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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Practical info

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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

forcing term

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

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

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.

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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

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Practical info

Location(s)

Toulouse