CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2025-2026

YEAR 1

CONTROL AND ROBOTICS

EUROPEAN MASTER ON CONTROL OF RENEWABLE ENERGY SYSTEMS (EU CORE)

PROGRAMME SUPERVISOR(S):
Franck PLESTAN,Mohamed Assaad HAMIDA

YEAR 1 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
LINCO	Linear control systems	4
NOLCO	Nonlinear control systems	4
POWCON	Power Conversion	4
PROJECT	Wind energy project	4
RENEN	Renewable energy systems	4
WENER1	Wind Energy 1	4
WENER2	Wind Energy 2	4

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE1	Cultural and Communication English	2
ESP1	Spanish Language	2
FLE1	French Language	2

Linear control systems [LINCO]

LEAD PROFESSOR(S): Guy LEBRET

Requirements

A first course on classical control. A course on linear differential equations. A course on linear algebra.

Objectives

Two parts in this course: a short review of the basis of classical control of SISO linear systems, and a second part to develop the state space approach of the control of MIMO linear systems.
In the first part, four chapters: «from open loop to closed loop», «stability», «performances», these are the chapters on the analysis of SIS dynamical systems. And finally, a chapter on the "synthesis of PID type controllers" for linear SISO dynamical systems.
In the second part, three chapters on the analysis of systems «time domain responses- modal decomposition», «controllability», «observability», and then three chapters on design of control laws for MIMO systems: «state feedback», «observers», «state estimated feedback».

Course contents

First part, the review of classical control :
- From open loop to closed-loop
- Stability
- Performances
- Synthesis of PID-type controllers

Second part, the control of MIMO linear dynamical systems:
- time domain responses- modal decomposition
- Controllability and Observability
- state feedback and observers
- State estimated feedback

Course material

- "Control Systems Engineering", N. S. Nise, John Wiley & Sons, 2011.
- "Control system design", G.C. Goodwin, S.F. Graebe and M.E. Salgado, Prentice Hall, 2001.
- "Linear Multivariable Control, A Geometric Approach", W.M. Wonham. Springer Verlag, 1985
- "Modern control systems", R.C. Dorf et R.H. Bishop, 12th. edition, Pearson Prentice Hall, 2011
- "Control system design", G.C. Goodwin, S.F. Graebe and M.E. Salgado, Prentice Hall, 2001

Sustainable Development Goals (SDGs) covered by this course

Quality education

Sustainable Development and Social Responsibility Positioning

High-quality teaching based on international scientific literature in the field. The developed control laws are used in the industrial world.

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	18 hrs	4 hrs	8 hrs	0 hrs	2 hrs

Nonlinear control systems [NOLCO]

LEAD PROFESSOR(S): Franck PLESTAN

Sustainable Development Goals (SDGs) covered by this course

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	6 hrs	12 hrs	0 hrs	2 hrs

Power Conversion [POWCON]

LEAD PROFESSOR(S): Mohamed Assaad HAMIDA

Sustainable Development Goals (SDGs) covered by this course

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	16 hrs	2 hrs	12 hrs	0 hrs	2 hrs

Wind energy project [PROJECT]

LEAD PROFESSOR(S): Franck PLESTAN

Sustainable Development Goals (SDGs) covered by this course

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

Renewable energy systems [RENEN]

LEAD PROFESSOR(S): Pierre MARTY

Objectives

Upon completion of this course, students will be able to:
- Understand the principles of sustainable development, circular economy, and energy transition.
- Analyze the role of renewable energies and resource use in energy systems.
- Apply the methodological foundations of Life Cycle Assessment (LCA).
- Perform and interpret a simplified LCA, including a wind farm case study.
- Develop skills in critical analysis, teamwork, and oral communication.

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Climate action / Industry, innovation and infrastructure / Life on land

Sustainable Development and Social Responsibility Positioning

This course is fully aligned with sustainable development and Corporate Social Responsibility (CSR) principles. It provides students with tools to assess environmental impacts across the full life cycle of energy systems and to support responsible decision-making in energy transition strategies.

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	14 hrs	4 hrs	0 hrs	2 hrs

Wind Energy 1 [WENER1]

LEAD PROFESSOR(S): Sandrine AUBRUN

Objectives

The aim of the course is to give the basics on the fluid mechanical aspects of a wind turbine operation that is needed to address, in an expert way, a problem of wind turbine or wind farm control.
After drawing the overall panorama of the current wind energy capacity worldwide and in Europe, the general operating principles of a wind turbine and its components are described.
Then, the course addresses all the fluid mechanical aspects of the system: the driving source of energy, i.e. the wind, the wind resource assessment and the power production, the airfoil and rotor aerodynamics, the wake effects.

Course contents

▪ Key wind energy figures, potential and installed wind power capacity worldwide and in Europe, major development challenges
▪ Standard wind turbine components and general operating principles (rotor, transmission chain, generator, structures and foundations)
▪ Basics of meteorology and the atmospheric boundary layer: global meteorological mechanisms, characteristics and physics of the atmospheric boundary layer, wind resources
▪ Power production and park effects
▪ Aerodynamics of airfoils, theories and models
▪ Rotor aerodynamics, theories and models

Numerical tutorials accompany this programme to learn how to estimate wind turbine output, estimate wind farm effect losses, study the performances and aerodynamic loads acting on a horizontal axis wind turbine, learn how to design a horizontal-axis wind turbine by using open-access multi-physics simulation tools as OpenFast or Qblade.

Course material

- Introduction to wind energy systems 2013, Springer-Verlag Berlin and Heidelberg GmbH & Co. K
- Wind Energy Handbook, 2001 John Wiley & Sons, Ltd
- Wind energy explained, - Theory, Design and Application. 2009 John Wiley & Sons, Ltd
- Wind resource assessment - A practical guide to developing a wind project. 2012 John Wiley & Sons, Ltd

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Industry, innovation and infrastructure / Responsible consumption and production

Sustainable Development and Social Responsibility Positioning

This course is entirely devoted to wind energy, which is a form of carbon-free energy. It aims to contribute significantly to reducing greenhouse gas emissions in the energy sector by exploiting locally available renewable energy sources. All of the lectures, tutorials and practical sessions in this module deal with sustainable development.

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	17 hrs	4 hrs	10 hrs	0 hrs	1 hrs

Wind Energy 2 [WENER2]

LEAD PROFESSOR(S): Mathias LEGRAND / Vincent MAHE

Requirements

Algebra, Differential equations, engineering systems

Objectives

Acquire skills in mechanical modelling, vibration analysis, aeroelasticity analysis

Course contents

1. Mechanical modelling
2. Vibrations of 1 degree-of-freedom systems
3. Vibrations of N degrees-of-freedom systems
4. Aeroelasticity

Course material

Mechanical vibrations, Geradin and Rixen, 2015

Sustainable Development Goals (SDGs) covered by this course

Industry, innovation and infrastructure

Sustainable Development and Social Responsibility Positioning

Design more robust mechanical systems, which will last longer in time

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	18 hrs	4 hrs	8 hrs	0 hrs	2 hrs

Cultural and Communication English [CCE1]

LEAD PROFESSOR(S): David TROYA

Objectives

This course aims at improving your critical thinking and persuasion skills in English. Using documentaries, we will explore, discuss and debate a range of cultural, political, social, and environmental issues relevant to current world events.

Speaking and understanding English as a second or third language is a great achievement, but does it mean you are an effective communicator? The next step involves, among other things, critical thinking and persuasive skills, both of crucial importance in the modern professional environment. We will address these issues by analyzing documentaries that will lead to formal debates.

Several competencies will be developed through class exercises. Oral presentations will be an opportunity put your verbal as well as your non-verbal communication skills into practice. During debate, you will be able to sharpen your analytical skills, provide constructive feedback, defend an argument, and prove a point.

Course objectives

- Improving your communication skills

- Becoming an active listener

- Enhancing your non-verbal communication skills

- Developing critical thinking toward media

- Boosting leadership skills through moderating

- Organizing evidence and arguments

Course contents

Each session will be dedicated to a particular cultural, political, social or environmental topic of relevance in the wider anglophone world. Each topic will include multimedia material in the form of a short documentary or documentary excerpt. During class, students will lead a primer presentation, a moderated discussion and a formal debate.

Primer Presentation:

In pairs, you will hold a short talk to prime us on the topic of that week's documentary: you will introduce us to the topic by setting it in a wider context and establishing what's at stake.

Moderated Discussion :

In pairs, you will moderate a discussion related to the themes explored by the documentary. Moderators will come prepared with open-ended questions pertaining to the strengths and weakness of the documentary. They will distinguish between content and form and encourage critical, constructive opinions.

Formal Debate:

What's the difference between an opinion and an argument? You will soon find out. After the moderated discussion, we will brainstorm potential topics for debate, and follow the British Parliamentary model to sharpen your research, critical thinking, and persuasive skills.

During the debate, each speaker will be assigned an audience member who evaluates their individual performance and provides a short debrief. A panel of two judges will determine which side wins.

Course material

Written and televised press, information and digital tools, general documents, business environment and company strategies. Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle).

Sustainable Development Goals (SDGs) covered by this course

Climate action / Industry, innovation and infrastructure / Partnership s for the goals / Quality education / Reduced inequalities

Assessment

Individual assessment: EVI 1 (coefficient 1.0)
EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Spanish Language [ESP1]

LEAD PROFESSOR(S): Marta HERRERA

Objectives

For beginners:
Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)
Acquisition of vocabulary and linguistic structures
Be able to talk about yourself and those around you
Be able to express oneself during daily activities
Know how to give your opinion

For advanced students:
Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)
Acquisition of specialised vocabulary
Be able to understand the essential content of concrete or abstract subjects including a technical discussion
Be able to communicate spontaneously and fluently
Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:
Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)
Present tense (regular and irregular)
Language patterns to express habit, obligation, "gustar" and its equivalents,
Possessive adjectives
Differences between "es", "está", "hay"
Use of "por" and "para"
Adverbs and frequency patterns
Numeral adjectives

For advanced students:
Knowledge of the Hispanic world (economic, technical, cultural and social environment)
Present tense (regular and irregular)
Imperative
Past tenses
Direct / indirect style
Future tense
Conditional tense
Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Sustainable Development Goals (SDGs) covered by this course

Affordable and clean energy / Climate action / Decent work and economic growth / Gender equality / Goo health and well-being / Industry, innovation and infrastructure / No poverty / Partnership s for the goals / Peace, justice and strong institutions / Quality education / Reduced inequalities / Responsible consumption and production / Sustainable cities and communities / Zero hunger

Sustainable Development and Social Responsibility Positioning

Key competencies for sustainability Collaboration: the abilities to learn, to understand and respect others; to deal with conflicts in a group; and to facilitate collaborative and participatory problem solving. Critical thinking: the ability to reflect on one's own values, perceptions and actions. Self-awareness: the ability to reflect on one's own role in a group; to continually evaluate and further motivate one's actions; and to deal with one's feelings and desires.

Assessment

Individual assessment: EVI 1 (coefficient 1)
EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Spanish	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

French Language [FLE1]

LEAD PROFESSOR(S): Silvia ERTL

Requirements

N/A

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources.
Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture. At the end of the course (2 semesters), complete beginners can achieve an A1 level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.

Learners will be able to use the foreign language in a simple way for the following purposes:

1. Gving and obtaining factual information:
- personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

2. Establishing and maintaining social and professional contacts, particularly:
- meeting people and making acquaintances
- extending invitations and reacting to being invited
- proposing/arranging a course of action
- exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

3. Carrying out certain transactions:
- making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- making purchases

- ordering food and drink

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Sustainable Development Goals (SDGs) covered by this course

Quality education

Sustainable Development and Social Responsibility Positioning

Targeted competencies extracted from: Education for sustainable development goals, learning objectives (UNESCO) https: //unesdoc.unesco.org/ark:/48223/pf0000247507 https://www.coe.int/fr/web/common-european-framework-reference-languages/official-translations-of-the-cefr-global-scale

Assessment

Individual assessment: EVI 1 (coefficient 1.0)
EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	48 hrs	0 hrs	0 hrs	0 hrs