CENTRALE NANTES

ENGINEERING PROGRAMME

2023-2024

Year 2 / Year 3

Specialisation option

Low-tech engineering

OD LOWTECH

PROGRAMME SUPERVISOR

Jean-Marc BEN GUIGUI

Autumn Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 73 / 93	12	Core course	EXPLORE1 EXPLORE2 LOWTEC1	Discovery and exploration of low-tech systems 1 Discovery and exploration of low-tech systems 2 Low-tech Project 1
UE 74 / 94	13	Core course	COFALOW1 COFALOW2 LOWTEC2	Low-tech design and manufacturing 1 Low-tech design and manufacturing 2 Low-tech Project 2

Spring Semester

Course unit	ECTS Credits	Track	Course code	Title
UE 103 / 83	14	Core course	HORIZONS1 HORIZONS2 LOWTEC3	Capitalization and transfer of low-tech systems 1 Capitalization and transfer of low-tech systems 2 Low-tech Project 3

Discovery and exploration of low-tech systems 1 [EXPLORE1]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

- Discover the low-tech approach to apply it
- Explore low-tech solutions for inspiration
- Research ideas and concepts to reduce environmental impacts
- Specify the problem and define the useful and essential needs of a system
- Define project specifications
- Apply eco-design, evaluation and management methods and tools
- Mobilize knowledge in other disciplines (energy, mechanics, electronics, etc.)

Course contents

Low-tech approach :

- Environmental (finitude of resources, planetary limits and food), social and economic issues
- Introduction, definitions and characteristics of low-tech systems
- Travels and meetings with the various low-tech actors (Associations, social and solidarity economy, companies and industries) in different fields of application: energy, food, water, waste management, materials, habitat, transport, hygiene or even health.

Methods and tools for eco-design, environmental assessment and management :

- Eco-design and its tools
- Needs, functional and value analysis
- Accounting for greenhouse gas (GHG) emissions
- Life cycle analysis (LCA) : From the extraction of raw materials to the end of life

Project engineering :

- Basics of project management (Reminder)
- Agile method
- Introduction to scientific research

Course material

ADEME. (2022). Etat des lieux et perspectives des démarches "low-tech"
Bellini, B., & Janin, M. (2019). Écoconception : état de l'art des outils disponibles. Techniques de l'ingénieur.
AFNOR. (2013). Management environnemental – Aide à la mise en place d'une démarche d'éco-conception. NF X30-264

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Discovery and exploration of low-tech systems 2 [EXPLORE2]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

- Discover the low-tech approach to apply it
- Explore low-tech solutions for inspiration
- Research ideas and concepts to reduce environmental impacts
- Specify the problem and define the useful and essential needs of a system
- Define project specifications
- Apply eco-design, evaluation and management methods and tools
- Mobilize knowledge in other disciplines (energy, mechanics, electronics, etc.)

Course contents

Physics applied to low-tech :

- Thermodynamics
- Energy: Renewable, distribution networks, etc.
- Thermal
- Fluid mechanics
- Kinetic mechanics
- Plumbing
- Electronics: sensors, arduino, ...
- IT: Raspberry Pi, ...

Course material

ADEME. (2022). Etat des lieux et perspectives des démarches "low-tech"
Bellini, B., & Janin, M. (2019). Écoconception : état de l'art des outils disponibles. Techniques de l'ingénieur.
AFNOR. (2013). Management environnemental – Aide à la mise en place d'une démarche d'éco-conception. NF X30-264

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Low-tech Project 1 [LOWTEC1]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

This specialisation is based on project-based learning. The installation of low-tech systems in a catamaran should allow students to complete their training in the field. They will also be expected to learn for themselves anything that is not covered in the lessons.

Goals:
- Design and refit a catamaran
- Develop low-tech solutions in a catamaran with regard to energy, and thermal, climatic, air and water management
- Optimize and validate catamaran systems by integrating it into its eco-system (base and territory)
- Evaluate their ecological, economic and ergonomic impacts.
- Study of the marketing concept of the various validated systems and their industrialization

Course contents

Period 1 of the project corresponds to the main stages of:
- Exploration
- Planning

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	6	0 hrs	0 hrs	0 hrs	136 hrs	0 hrs

Low-tech design and manufacturing 1 [COFALOW1]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

- Generate low-tech solutions to address environmental issues
- Specify the technical solutions adopted
- Modeling technical solutions from a conceptual and environmental point of view
- Search for materials and suppliers who can meet the specifications
- Prototype low-tech systems
- Check if the system meets the criteria of the specifications

Course contents

Design and prototyping :

- 3D design: FreeCAD
- Fablab and prototyping
- Design at the service of low-tech

Materials and processes for low-techs :

- Choice of material by Ashby's method
- Sizing. Material Strength Elements
- Metallic materials: ferrous alloys and others
- Study and redesign of a commonly used product.
- Implementation of welding / boilermaking / wood processes
- The wood material and its derivatives

Course material

Allwood, J. M., Cullen, J. M., (2012). Sustainable materials: with both eyes open. UIT Cambridge Limited.
Ashby, M. F. (2011). Matériaux et environnement: choix éco-responsable en conception. Dunod.
Ashby, M. F. (2012). Materials and the environment: eco-informed material choice. Butterworth-Heinemann Inc

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Low-tech design and manufacturing 2 [COFALOW2]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

- Generate low-tech solutions to address environmental issues
- Specify the technical solutions adopted
- Modeling technical solutions from a conceptual and environmental point of view
- Search for materials and suppliers who can meet the specifications
- Prototype low-tech systems
- Check if the system meets the criteria of the specifications

Course contents

Concepts around low-tech :

- Circular economy: Responsible consumption, reuse, recyclability...
- Economy of functionality
- Recyclability of materials

Project engineering :

- Collective intelligence and support for change
- Responsible management
- Drafting of deliverables

Course material

Le Moigne, R. (2018) L'économie circulaire: Stratégie pour un monde durable. Dunod. (2ème édition).
Sousa Cardoso, C. d., & Messina, J.-C. (2019). 121 outils pour développer le collaboratif: animer l'intelligence collective dans vos réunions, ateliers, séminaires. Eyrolles.
Grosse, François (2010). Le découplage croissance / matières premières. De l'économie circulaire à l'économie de la fonctionnalité: vertus et limites du recyclage. Futuribles.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Low-tech Project 2 [LOWTEC2]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

This specialisation is based on project-based learning. The installation of low-tech systems in a catamaran should allow students to complete their training in the field. They will also be expected to learn for themselves anything that is not covered in the lessons.

Goals:
- Design and refit a catamaran
- Develop low-tech solutions in a catamaran with regard to energy, and thermal, climatic, air and water management
- Optimize and validate catamaran systems by integrating it into its eco-system (base and territory)
- Evaluate their ecological, economic and ergonomic impacts.
- Study of the marketing concept of the various validated systems and their industrialization

Course contents

Period 2 of the project corresponds to the main stages of:
Design
Prototyping
Development & testing

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	7	0 hrs	0 hrs	0 hrs	136 hrs	0 hrs

Capitalization and transfer of low-tech systems 1 [HORIZONS1]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

- Improve systems based on feedback
- Study the industrialization and adaptation of systems to other appropriate uses
- Sharing and transferring knowledge and know-how
- Communicate around a project to inspire others
- Deepen your low-tech culture and thinking

Course contents

Deepening of low-tech and other related concepts :

- Biomimicry, natural environments, eco-toxicity
- Alternative mobility
- Engineering ethics
- Main thinkers who inspired low-tech and philosophy
- Other concepts close to the low-tech philosophy

Course material

Bihouix, P. (2014). L'âge des low tech: vers une civilisation techniquement soutenable. Éditions du Seuil.
Ellul, J. (1988) Le bluff technologique.
Franklin, U. (1989). The Real World of Technology.
Illich, I., Giard, L., & Bardet, V. (1973). La convivialité. Editions du Seuil.
Jevons, W. (1865). The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal Mines.
Mumford, L. (1966). Le Mythe de la machine, technique et développement humain.
Schumacher, E. (1973). Small is Beautiful: A Study of Economics As If People Mattered.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Capitalization and transfer of low-tech systems 2 [HORIZONS2]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

- Improve systems based on feedback
- Study the industrialization and adaptation of systems to other appropriate uses
- Sharing and transferring knowledge and know-how
- Communicate around a project to inspire others
- Deepen your low-tech culture and thinking

Course contents

Project engineering :

- Industrialization and market research
- Capitalization and feedback
- Responsible communication
- Sharing knowledge and commons

Course material

Bihouix, P. (2014). L'âge des low tech: vers une civilisation techniquement soutenable. Éditions du Seuil.
Ellul, J. (1988) Le bluff technologique.
Franklin, U. (1989). The Real World of Technology.
Illich, I., Giard, L., & Bardet, V. (1973). La convivialité. Editions du Seuil.
Jevons, W. (1865). The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal Mines.
Mumford, L. (1966). Le Mythe de la machine, technique et développement humain.
Schumacher, E. (1973). Small is Beautiful: A Study of Economics As If People Mattered.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	3	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Low-tech Project 3 [LOWTEC3]

LEAD PROFESSOR(S): Jean-Marc BEN GUIGUI

Objectives

This specialisation is based on project-based learning. The installation of low-tech systems in a catamaran should allow students to complete their training in the field. They will also be expected to learn for themselves anything that is not covered in the lessons.

Goals:
- Design and refit a catamaran
- Develop low-tech solutions in a catamaran with regard to energy, and thermal, climatic, air and water management
- Optimize and validate catamaran systems by integrating it into its eco-system (base and territory)
- Evaluate their ecological, economic and ergonomic impacts.
- Study of the marketing concept of the various validated systems and their industrialization

Course contents

Period 3 of the project corresponds to the main stages of:
- Transfer & industrialization
- Product review and capitalization

Course material

Assessment

Collective assessment: EVC 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
French	8	0 hrs	0 hrs	0 hrs	136 hrs	0 hrs