ENSEGID [1]/Bordeaux INP [2] University diploma : "Ecological engineering and adaptation to climate change - EEACC"

Sustainable development and its various transitions require, in order to be taken into account, the implementation of a certain number of specific approaches and devices, particularly when it comes to of a phenomenon as complex and as global as climate change.

Whether it is upstream scientific research to properly identify current and future phenomena or the transfer of knowledge, higher education institutions have a key role in education, training and research on climate change. These approaches rely on coordinated approaches of the various actors in the territories to assess current situations and to plan for the future.

The University degree presented here aims to meet the expectations of the various actors in society in terms of adaptation to climate change at various environmental, socio-economic, political and cultural levels.

Definition and role of ecological engineering

Ecological engineering, defined as the application of ecological principles to environmental management, is assuming increasing importance due to the proliferation of local and global environmental problems, including climate change. Research in ecological engineering brings many elements that make it possible to respond, in concrete terms, to society's expectations in terms of education, training, information and the creation of the UD-EEACC corresponds to this approach.

Ecological engineering uses innovative concepts and techniques to better manage our local and regional environment. Considered a biotechnology of ecological systems, ecological engineering is a growing discipline in many countries. This engineering is based on the work of research teams from different disciplines and is inspired by nature and living things to preserve existing ecosystems, limit environmental impacts and improve the quality of our life.

The fields of application are numerous and faced with the reality of climate change, it is important to understand the main applications of ecological engineering, to know if the results are up to the challenges and to define the relevant perspectives.

This DE aims to complete the training of engineers or future engineers to provide them with scientific and technical skills enabling them to design and manage operational and strategic projects that globally take into account climate change and the essential adaptations to this change to enforce.

Considered as a biotechnology of ecological systems, ecological engineering draws inspiration from nature and living things to preserve existing ecosystems, limit environmental impacts and improve the quality of daily life. Ecological engineering is built on a multidisciplinary and interdisciplinary approach which relies on fundamental research and applied research in environment and sustainable development to encourage technology transfers to socio-economic actors so that they can develop strategic approaches. most relevant in view of the situations they are faced with.

Ecological engineering concerns a wide range of issues relating to the environment and sustainable development and, thereby, refers to many disciplines:

- engineering sciences and techniques mobilized for the evaluation of resources, for the prevention of natural disasters or the mitigation of their effects;
- human and social sciences through the modalities of land use planning and organization of economic activities to minimize anthropogenic impacts on the environment;
- life sciences with the rehabilitation of degraded ecosystems, the reintroduction of species, or the creation of new sustainable ecosystems of value for man and for the biosphere;
- in situ management of ecological systems and the development of biological tools to maximize ecosystem service or to solve pollution problems.

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[1] **ENSEGID** – National Institute on Environment, Georesources, Image and Sustainable Development - is one of the eight engineering schools which make up the National Polytechnics Institute – IPB - of the University of Bordeaux

[2] **Bordeaux INP** - National Polytechnic Institute of Bordeaux - is a higher education establishment which brings together engineering schools in New Aquitaine.

ENSEGID and climate change

The issues related to the environment and sustainable development underline the need to better mobilize the researcher in order to make fundamental research and finalized research interact more closely on issues affecting the future of the planet (climate change, scarcity of resources, loss of biodiversity, pollution, risks to human safety, etc.) in response to society's expectations.

ENSEGID contributes significantly to the development of ecological engineering by focusing on environmental and sustainable development issues, including climate change and its adaptations, by developing research with a strong methodological and technological component and by transferring applications that result for the benefit of the various actors of our society.

This diploma is therefore part of an approach undertaken for several years by ENSEGID to provide the various actors with the knowledge necessary to implement their strategy of adaptation to climate change by considering the populations replaced within their various environments and activities. Thus, the themes covered in the DE are closely linked, whether it is agriculture, biodiversity, climatology, economics, sociology, the quality of natural environments, water resources, etc. etc. These themes are carried out in conjunction with the Acclima Terra[3] and Ecobiose[4] programs.

Description of the Diploma

Faced with climate change, ecological engineering makes it possible to develop strategies to preserve ecosystems, limit environmental impacts and improve the quality of life of populations. The purpose of the DE IEACC is to train learners in the identification and implementation of these strategies within the framework of a three-part course :

- a common core of 100 hours;
- optional modules of 20 hours;
- a dissertation on a practical case study.

The common core concerns the knowledge and skills that any person enrolled in the DE will have to possess, while the optional modules will be defined according to the recruitment of learners, their specificities and their expectations. The individual application will focus on the analysis of a concrete case.

The multidisciplinary nature of the DE must allow learners to integrate all dimensions, in particular ecological, spatial, social and economic, of the projects envisaged. The training is based on a balance between basic lessons, specialized lessons and workshops which will relate to the following areas:

- Sciences and techniques: ecological engineering and environmental sciences, biodiversity,...;
- Human and social sciences: ecological economics, environmental law, planning economics, sociology,...;
- Project design and management: foresight and diagnosis, project theory and practice, etc.

❖ Areas of intervention :

- Analysis and prospective of territories and the environment:
- Foresight and diagnosis, territorial and environmental,
- Strategic planning and spatialization of territorial projects, ...
- Urban, territorial and environmental design:
- Monitoring of the application of the operational program, assessment and evaluation; etc.

❖ Targeted professions :

- Project manager for the analysis and prospective of territories and the environment (diagnosis, strategic planning and spatialization of territorial projects;
- Project manager for urban, territorial and environmental design (application of operational program, assessment and evaluation);
- Head of department or study office in planning and environment (management and restoration of natural environments); etc ...

[3] **Acclima Terra** is a program developed within the framework of an association of 200 scientists working on adaptation to climate change in the Nouvelle Aquitaine region.

[4] **Ecobiose** is an interdisciplinary scientific program on Biodiversity and Ecosystem Services developed in the Nouvelle-Aquitaine region

Course content

The course consists of 5 different teaching and training activities for a total of 120 hours spread out over 4 months and completed by the production of an application internship dealing with a concrete case:

- part 1: climate change and its consequences (10 hrs);
- part 2: definition, issues and actors of ecological engineering (30 hrs);
- part 3: Ecological engineering and adaptation to climate change (30 hrs)
- part 4: What future for ecological engineering on adaptation to climate change (30 hrs)
- part 5: Optional modules (20 hrs)
- part 6 : Application internship on a practical case study

➢ Part 1 : Climate change and its consequences (10 hrs)

Main characteristics of climate change :

Which parameters determine and regulate the Earth's climate. Modifications of these parameters result from changes due to natural processes, intrinsic to the Earth or linked to external influences (astronomical) and taking place over large time scales (*e.g.* ice age), but can also occur at shorter timescales due to anthropogenic actions.

Adaptation to climate change :

Analysis of climate change adaptation strategies that aim to reduce the vulnerability of natural and human systems against the current or projected effects of climate change. These adaptation strategies, which complement measures to mitigate greenhouse gas emissions, are essentially aimed at adopting individual and global behaviors intended to cope with decades of anthropogenic climate disturbances.

➢ Part 2: Definition, issues and actors of ecological engineering (30 hrs)

Definition of ecological engineering :

Which grid of criteria and issues is relevant to define the contours of ecological engineering.

What is a system in ecology? :

The notion of system in ecology highlights the existence of many feedbacks, positive or negative and underlines the stake represented by the apprehension of these systemic loops for an ecological engineering .

Organisms "engineers of the ecosystem" :

The notion of organism engineer of the ecosystem is defined then explained by various examples by highlighting the importance of these organisms in the functioning of ecosystems, and in particular agroecosystems.

Biodiversity, functioning and stability of ecosystems :

Description of the relationship between biodiversity, functioning and stability of ecosystems through studies based on plant communities and their various trophic levels .

Ecosystem services and multifunctionality :

What is the relationship between ecological engineering, ecosystem services and multifunctionality. Analyzing ecosystems from the perspective of the services they provide to human societies , we show what the purpose of human interventions should be .

Management of ecosystem services :

Management of the complexity of ecosystems is approached through the concept of ecosystem services. Based on examples such as nature in the city or green roofs, it shows the elements on which the search for thresholds and compromises in ecological engineering strategies should be based .

➢ Part 3 : Ecological engineering and adaptation to climate change (30 hrs)

Examples of implementation of ecological engineering :

Some concrete examples of implementation of ecological engineering, in opposition to or in addition to civil or conventional engineering solutions generally implemented: coastal, mountainous, agricultural, and urban .

Political ecology and ecological engineering :

Presentation of the relationship between political ecology and ecological engineering by retracing their respective geneses and showing the need to strengthen this relationship .

Methodology of ecological compensation :

Implementation contexts, operating methods, feasibility, indicators, pooling, proximity, description of different types of measures and associated issues .

Planned obsolescence, theoretical issues and practical cases :

Description of the concept of planned obsolescence. From its inclusion in French law to the accusations made to several industrial groups, description of current events and the games of actors .

Modeling as a tool for integrating ecological processes :

The modeling of systems and the interests and major types of tools associated with this approach, and, more specifically, on the question of modeling in ecology: what are the challenges and what are "ecosystem simulators"?

Adaptation measures and their societal acceptance :

The term adaptation refers to an ability to adjust, and therefore a dynamic view of how societies operate. But, it is not enough to be aware of and know the impacts of our lifestyles on climate change and on the scarcity of fossil resources to change our behavior because there are many psychological barriers to these changes. This module will focus on the disjunction between people's attitudes and behaviors and on how to remedy it.

- **Part 4 : What place for ecological engineering in our societies (30 hrs)**

• **Economic questions around ecological engineering** :

Several economic questions related to the deployment of ecological engineering are addressed: benefits acquired in various fields of activity, public instruments to encourage the use of ecological engineering, benefits for society of this ecological engineering based on nature, importance of this sector of activity in terms of employment and in terms of indirect activities generated in the territories concerned.

• **Ecological engineering and business** :

What prospects does ecological engineering offer to companies? This sector of activity is still young, particularly in France, but several examples underline the interest of developing this type of approach, in addition to, or even in substitution for, technical approaches that are still too widely and too systematically used. What are the levers and obstacles to study in order to support transformations within companies?

• **Ecological engineering and sustainable cities** :

Due to climate change, average temperatures will increase during the 21st century. Several approaches are being considered to adapt cities by seeking the optimal association between different possible solutions promoting ecological and social equality: urban density vs urban sprawl, eco-districts, revegetation, health impact, etc. This involves analyzing in particular the way in which vegetation is introduced into the various urban development plans by considering their potential for mitigating the impacts of climate change.

• **Ecological engineering and agriculture** :

The search for solutions through ecological engineering based on nature sheds new light on strategies for combating climate change by referring to actions to preserve and restore ecosystems while contributing to both mitigation of this warming (carbon capture and storage) and its adaptation (protection against storms, floods, landslides). The implementation of concrete solutions - socially, ecologically and economically acceptable - require a better diversification of agriculture, the protection of biodiversity and specific habitats, the development of urban / peri-urban agriculture projects in the territories or even the strengthening of carbon storage in soils and biomass. through appropriate practices.

- **Part 5 : Optional modules (20 hrs)**

Part of the course will be reserved for the realization of optional modules. The content of these modules will be adapted according to the specific needs of the learners.

This optional part aims to seek to provide the most appropriate answers to various categories of learners according to their specificity and the expectations of the structures within which they exercise or will exercise their professional activities.

- **Part 6 : Dissertation on a practical case study**

The individual dissertation will focus on the analysis of a practical case defined jointly by a teacher from Bordeaux INP and an external partner belonging to the various components of society acting in relation to sustainable development and adaptation to climate change.

Academic Calendar

The diploma will take place during the second trimester of every academic year :
- April to June : theoretical and practical lessons
- July to mid-September : practical case study
- Mid-September : presentation of the results of the case study
- End of September : proclamation of diploma results

The first edition of the diploma will start on the 4th of April 2022 and will be reserved for French-speaking students. The following editions will be aimed at both French-speaking and English-speaking students

The courses will be given both face-to-face and in distance education.

Diploma registration

The EEACC diploma is part of the continuing education of the National Institute on Environment, Georesources, Image and Sustainable Development (ENSEGID) acting within the framework of the National Polytechnic Institute of Bordeaux (Bordeaux INP)and its ENSEGID component

Continuous training actions allow students at the end of their course and professionals already in activity to train in order to enrich or extend their fields of expertise. ENSEGID relies on the expertise and know-how of its trainers (teacher-researchers and engineers) to offer you training in the field of Ecological engineering and adaptation to climate change.

Registration for the diploma for the Academic year 2021-2022 will be done from January 10, 2022 on the following site :

https://ensegid.bordeaux-inp.fr/fr/formulaire-de-pre-inscription-en-formation-continue

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